Department of Energy

Oak Ridge Operations Office
P.O. Box 2001
Oak Ridge, Tennessee 37831—

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March 3, 2003

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Dear Stakeholder:

NATIONAL ENVIRONMENTAL POLICY ACT FINDING OF NO SIGNIFICANT IMPACT AND ENVIRONMENTAL ASSESSMENT FOR WASTE DISPOSITION ACTIVITIES AT THE PADUCAH SITE, PADUCAH, KENTUCKY

The United States Department of Energy (DOE) has completed the Environmental Assessment (EA) for Waste Disposition Activities at the Paducah Site, Paducah, Kentucky. DOE has determined that the proposed waste disposition action is not a major federal action that would significantly affect the quality of the human environment within the context of the National Environmental Policy Act of 1969 (NEPA). Therefore, preparation of an Environmental Impact Statement is not necessary, and DOE is issuing a Finding of No Significant Impact (FONSI).

A-00005-2741

In accordance with DOE NEPA Implementing Procedures, 10 CFR 1021.301 (61 FR 64603, December 6, 1996) DOE is providing affected states, as well as the general public, with a copy of the final EA as well as the FONSI.

If you have any comments, questions, or concerns about this EA, please forward them to:

David R. Allen
United States Department of Energy
Oak Ridge Operations Office
200 Administration Road
Oak Ridge, Tennessee 37830
Phone: (865) 576-0411
Fax: (865) 576-0746

For further information about the NEPA process, please contact me at (865) 576-0411.

Sincerely,

David R. Allen
ORO NEPA Compliance Officer

Enclosure

DOE/EA-1339

Final Environmental Assessment for Waste Disposition Activities at the Paducah Site Paducah, Kentucky

DEPARTMENT OF ENERGY • UNITED STATES OF AMERICA •

FINDING OF NO SIGNIFICANT IMPACT
WASTE DISPOSITION ACTIVITIES AT THE PADUCAH SITE
PADUCAH, KENTUCKY

AGENCY: U.S. DEPARTMENT OF ENERGY

ACTION: FINDING OF NO SIGNIFICANT IMPACT

SUMMARY: The U.S. Department of Energy (DOE) has completed an environmental assessment (DOE/EA-1339), which is incorporated herein by reference, for proposed disposition of polychlorinated biphenyl (PCB) wastes, low-level radioactive waste (LLW), mixed low-level radioactive waste (MLLW), and transuranic (TRU) waste from the Paducah Gaseous Diffusion Plant Site (Paducah Site) in Paducah, Kentucky. All of the wastes would be transported for disposal at various locations in the United States. Based on the results of the impact analysis reported in the EA, DOE has determined that the proposed action is not a major federal action that would significantly affect the quality of the human environment with in the context of the National Environmental Policy Act of 1969 (NEPA). Therefore, preparation of an environmental impact statement is not necessary, and DOE is issuing this Finding of No Significant Impact (FONSI).

PUBLIC AVAILABILITY OF EA AND FONSI: The EA and FONSI may be reviewed at and copies of the document obtained from:

Gary Bodenstein, NEPA Document Manager
U.S. Department of Energy
5600 Hobbs Road
West Paducah, KY 42001
(270) 441-6831

Paducah Public Library
555 Washington Street
Paducah, KY 42001

FURTHER INFORMATION ON THE NEPA PROCESS: For further information on the NEPA process, contact

David R. Allen, NEPA Compliance Officer
U.S. Department of Energy
200 Administration Road
Oak Ridge, TN 37831
(865) 576-0411

BACKGROUND: DOE must continue to manage (i.e., treat, store, and dispose) and control its wastes safely, efficiently, and cost effectively in compliance with applicable federal and state laws while protecting public health and the environment. The wastes considered in the assessment are limited to DOE's ongoing and legacy non-CERCLA waste management operations at the Paducah Site. These wastes include LLW, MLLW, and TRU waste, as well as materials stored in DOE Material Storage Area (DMSAs). Also included is storage of USEC program wastes, which are characterized as one or more of these waste types. Wastes not covered in this EA are those associated with the Comprehensive

Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) activities, including decontamination and decommissioning activities, and disposition of wastes associated with United States Enrichment Corporation (USEC) operational activities. The cumulative impacts section of the EA does take these wastes into consideration.

The assessment is intended to supplement and update the previous NEPA evaluation of waste disposition activities conducted as part of the final Waste Management Programmatic Environmental Impact Statement (WM-PEIS) for radioactive and hazardous waste. This assessment expands the scope of previous analyses to include possible transportation to commercial facilities.

DOE's proposed action includes waste disposition activities such as storage, on-site treatment, waste transport to off-site treatment and disposal facilities, waste management supporting activities, and DMSA waste characterization. The following table summarizes the proposed action:

Activity	Proposed Action
Storage	Storage at the Paducah Site until scheduled for treatment, disposal, or transport from the Paducah Site. Existing facilities would be used for waste storage. Applies to all wastes evaluated.
On-Site Treatment	On-site treatment would be conducted in existing facilities and treatment technologies are neutralization, solidification, carbon adsorption, and photocatalytic conversion. Applies to approximately 200 m^3 (7060 ft^3) of the 11,000 m^3 (390,000 ft^3) volume of wastes.
Waste Transport	Transport to off-site treatment and disposal facilities by truck, rail or intermodal carrier. Representative receiving locations include: Andrews, Texas; Deer Park, Texas; Hanford, Washington; Clive, Utah; Mercury, Nevada; Oak Ridge, Tennessee; Atomic City, Idaho, and Calsbad New Mexico.
Waste Management Supporting Activities	Supporting activities include waste staging, on-site waste movement, packaging, repackaging, sorting, volume reduction, waste container decontamination, inspection, labeling, characterization, facility modifications and/or upgrades, and others as necessary for waste management and maintenance.
DMSA Waste Characterization	Nuclear Criticality Safety (NCS) characterization in addition to standard waste management operations. Based upon the completion of the NCS characterization, standard waste management supporting activities would commence.

The impact analysis in the EA addressed the potential effects of storing all legacy and newly generated wastes on site, on site treatment of a subset of wastes (approximately 200m^3), waste handling, and transporting accumulated legacy and ongoing operations wastes from Paducah to destinations representative of other DOE sites and licensed commercial treatment/disposal facilities. The potential effects of transport over both highway and rail routes were evaluated. Evaluations of waste generation were estimated based on volumes anticipated over a 10 year life cycle. On-site treatment technologies are limited by the Paducah Site RCRA Part B permit. RCRA-permitted on-site treatment technologies include sedimentation, precipitation, oxidation, reduction, neutralization, and cementation/solidification. Of these treatment processes only neutralization, stabilization, carbon adsorption, and photocatalytic conversion are applicable to waste types included in the analysis. Building C-752-A is evaluated as the on-site treatment facility.

ALTERNATIVES: In addition to the proposed action, impacts were also evaluated for two alternatives 1) no action alternative and 2) enhanced storage.

No Action Alternative - In the No Action alternative (i.e., long-term storage), DOE would not perform disposition activities except for those needed for waste management and maintenance. No disposal of the existing and projected quantities of various wastes discussed under the proposed action would occur. Because existing storage space would be rapidly exhausted, new facilities would have to be constructed on-site to store newly generated wastes and some legacy wastes that cannot remain in outside storage. On-site treatment would be performed on wastes that require some type of stabilization prior to storage. Any on-site waste treatment requiring indoor processing would occur in Bldg. C-752-A or another suitable location. Relatively small volumes of waste would continue to be shipped to DOE or commercial facilities under existing categorical exclusions (CXs). As these CXs expire, no new ones would be placed, and the waste would then be stored on-site.

Enhanced Storage Alternative – The Enhanced Storage alternative (i.e., fortified, long-term storage) was added to the analysis as a result of public comments on the EA. This alternative is identical to the No Action alternative with the exception that storage facilities would be constructed for resistance to disasters (such as earthquakes and fires). No disposal of the existing and projected quantities of various wastes discussed under the proposed action would occur. Because existing storage space does not meet enhanced storage definitions, new facilities would have to be constructed on-site to store wastes.

ENVIRONMENTAL IMPACTS

PROPOSED ACTION

Radiological Risks

Radiological consequences for on-site treatment of waste - Detailed analysis of radiological impacts to the public and to workers resulting from on-site treatment of waste was performed in the EA. The analysis indicated that impacts are not notable for the entire treatment process or for individual waste stream groups.

Radiological Impacts from normal Truck Transportation - The potential effects of transporting waste by highway from Paducah to each of the potential final destination sites were evaluated on an annual basis during the major shipment year groupings and on a total 10-year shipping campaign basis. Truck shipments to receiving facilities were evaluated for the probability of a latent cancer fatality (LCF) to the truck crew, the general population, and the maximally exposed individual (MEI). It turns out that the worst-case results for the truck crew, general population, and MEI all occur during the shipment to Mercury, Nevada. However, all values were calculated to be less than 1 (largest value being 2.4×10^{-2} for the crew), so risks to these receptors are considered negligible.

Radiological Impacts from normal Rail Transportation – The potential radiological effects of routinely transporting LLW, MLLW, and TRU waste by rail from Paducah to each of the potential final destination sites were estimated for all waste subgroups on an annual basis during the major shipment year groupings and on a total 10-year shipping campaign basis. Rail shipments were evaluated for the probability of an LCF to the train crew, the general population, and the MEI. It turns out that the worst-case results for truck crew, general population, and MEI all occur during the shipment to Mercury, Nevada. However, all values were calculated to be less than 1 (largest value being 4.1×10^{-2} for the population), so risks to these receptors are considered negligible.

Nonradiological Risks. During the normal operations of the proposed action, it is estimated that the wastes are stored and monitored, transported to waste treatment locations on-site, and prepared for transportation off-site. It is estimated that these activities require 60 full-time equivalents or 120,000 person-h/year over the 10-year duration. Based on the 3.4×10^{-3}/200,000 person-h industrial fatality rate, 2.0×10^{-3} fatalities/year or 2.0×10^{-2} fatalities/ 10 years are expected as a result of industrial accidents.

Accident Analysis.

Handling Mishap - The computations for analyzing the vehicle mishap/mishandling accident evaluated the risks (expected fatalities) resulting from rupturing the ThF_4 drum or any of the 24 drums containing TRU waste. This analysis took into account the estimated accident frequency and the probability that the damaged drum would be either the ThF_4 drum or 1 of the 24 TRU waste drums out of a total of 56,000 drums. The results of the computations showed that the risk of the vehicle mishap/mishandling accident is negligible but slightly greater than for the EBE.

In addition to releases of radionuclides during a vehicle impact/mishandling accident, it is also possible that a PCB-containing transformer could be ruptured with ensuing combustion of the PCB oil. Concentrations of hydrochloric acid (HCl) and PCB soot arising from a PCB fire were calculated and compared to benchmarks. Neither the calculated HCl nor PCB soot occurs in concentrations that would create adverse health effects to the maximally exposed uninvolved worker (MUW) or MEI.

Evaluation Basis earthquake (EBE) – In the event of a major earthquake, the horizontal ground acceleration is estimated to be capable of creating differential movement between the top and bottom box layers, resulting in drums being toppled into the aisles. Two source terms were considered during the risk computations: the airborne source term (AST) in which radioactivity is released to, and dispersed by, the air; and the liquid source term (LST) in which radiologically contaminated liquids are released to, and dispersed by, surface water. In summary, the computed risks (expected fatalities) from radiological dose resulting from an EBE accident are negligible. Effects of exposure to toxic metals were also considered. No toxic metals are known to be in the liquid waste streams being considered in the EA. Therefore, only the AST was considered. The results of the computations demonstrate that the concentration of toxic metals in the AST resulting from an EBE would be negligible compared to the most conservative benchmark for human exposure.

Vehicle-Related Impacts – Potential vehicle-related impacts, including expected accidents, expected fatalities from accidents, and impacts from vehicle emissions were evaluated. Impacts from vehicle-related accidents and emissions were highest for the Mercury (Nevada Test Site), Nevada, and Clive (Envirocare), Utah, destinations because of the larger number of shipments and the total miles traveled to and from these destinations. However, vehicle-related impacts for these locations are calculated to be minimal. In addition, the radiological dose resulting from these accidents was calculated and the risk of LCFs to the general public were also calculated. The worst-case calculated number is far less than 1 LCF (1.5×10^{-3}) for shipment to Mercury, Nevada. For the entire waste transportation campaign, the calculated value is still less than 1 latent cancer fatality (2.5×10^{-3}).

Rail-Related Impacts – Potential rail-related impacts, including expected accidents, expected fatalities from accidents, and impacts from vehicle emissions were evaluated. Impacts from rail-related accidents and emissions are highest for the Mercury (Nevada Test Site), Nevada, and Clive (Envirocare), Utah, destinations because of the larger number of shipments and the total miles traveled to and from these destinations. However, all calculated values are much less than 1, indicating negligible impacts from rail-related accidents. In addition, the radiological dose resulting from these accidents was calculated and the risks of LCFs to the general public were also calculated. The worst-case calculated number is far less than 1 latent cancer fatality (1.6×10^{-3}) for shipment to Mercury, Nevada. For the entire waste transportation campaign, the calculated value is still less than 1 LCF (2.8×10^{-3}). Calculated population risk for rail transportation is equivalent to that for transportation by truck

Ecological resources.

Aquatic Biota – Under normal operations, impacts to aquatic biota from the proposed action should be negligible. Long-term impacts to aquatic biota would be beneficial after implementation of the proposed action, because much of the on-site waste would be removed reducing the amount stored on-site. The reasonable worst-case accident (earthquake) scenario involving radionuclides is unlikely to cause harm to aquatic biota in the Ohio River as a result of exposure to radionuclides. However, aquatic receptors in Bayou and Little Bayou creeks and other water conveyances by which the waste would reach the Ohio River would suffer minor impacts resulting from the caustic nature of the waste. Accident impacts analysis to aquatic biota from the reasonable worst-case accident scenario (earthquake) involving nonradionuclides indicated that PCBs are the only constituents whose ratio of concentration to toxicity benchmark (2.08) exceeds 1, indicating that PCBs could pose minor, short-term adverse impacts to aquatic biota in Bayou and Little Bayou creeks.

Terrestrial Biota - Short-term impacts to terrestrial biota from normal operations of the proposed activity should be negligible because the repackaging and on-site maintenance of wastes should not result in the release of constituents at concentrations that would be harmful to the biota. The accident scenario for chronic radionuclide exposure indicates that in this worst-case accident scenario (earthquake), long-term radiation effects to soil biota would be negligible. Two organics (PCBs and 1,2,4-trichlorobenzene) and two inorganics (cadmium and chromium) have modeled concentrations that would likely pose minor adverse impacts to soil biota if the worst-case spill accident occurred. However, these impacts would be reduced by the use of mitigative controls such as dikes, spill control measures, and expeditious cleanup.

Threatened and Endangered Species – Mussels including the orange-footed pimpleback (*Plethobasus cooperianus*), pink mucket pearly mussel (*Lampsilis arbrupta)*, ring pink (*Obovaria retusa*), fat pocketbook (*Potamilis capax*), as well as the Indiana bat (*Myotis sodalis*) are federally listed endangered species that may be found in or near McCracken County. No proposed operations or hypothesized accidents have been identified that would affect potential Indiana bat roosting or foraging habitat. Under normal operating conditions, any small quantities of PCBs released would not adversely affect the creeks or be expected to reach the Ohio River. However, if a highly unlikely or incredible accident were to occur, wastes might reach the Ohio River. During a flooding rainfall (which occurred less than once in 25 years), Bayou Creek, Little Bayou Creek, and the Ohio River would be flooded and sediments would move downstream. This would be a negligible addition to the concentration of contaminants already present in Ohio River sediments. This additional quantity of contaminants would be well within the measured variability of concentrations in river sediments. The addition of contaminants in the Ohio River would quickly (in minutes) pass mussel beds during flood conditions as sediments were moved rapidly downstream. An accidental release of contaminants would be extremely small and too brief to increase concentrations in the mussel species.

Noise. The normal operations of the proposed action within the Paducah Site boundaries would have no impact on the noise level at the site. Operation of trucks and drum-handling machinery, such as forklifts, and physical volume reduction machines, such as chippers and crushers, would occur. However, these activities currently take place at the site; therefore, no increase in the current noise level is anticipated.

Air quality. Emissions of criteria pollutants are the primary concern from area (nonpoint) sources such as waste packaging/sorting and storage areas. No notable emissions of criteria air pollutants are expected from the routine packaging, handling, and storage activities of existing or future generated waste at the Paducah Site.

All treatment activities would be conducted at existing facilities, so there would be no impacts from construction or site disturbance. The wastes proposed for on-site treatment would be processed by technologies, such as solidification, that historically have not produced notable air emissions and result in no anticipated ambient air impacts at the Paducah Site.

The Paducah Site anticipates making 762 waste shipments per year (up to 3 per day). During transportation, nonattainment areas are of most concern for potential air quality impacts. Nonattainment areas associated with each transportation route are associated with large metropolitan areas. Three shipments per day would not discernibly increase the daily rate of truck traffic for these metropolitan areas. In the *Environmental Assessment for Transportation of Low-Level Radioactive Mixed Waste from the Oak Ridge Reservation to Off-Site Treatment and Disposal Facilities* (DOE/EA-1317) analysis was undertaken to determine the impact of the proposed shipments relative to the threshold emission levels in nonattainment areas described by EPA in its air conformity regulations [40 *CFR* 93.153(b)(1)]. The receiving facilities for Paducah Site wastes are the same as in this analysis. The results determined that air emissions within all nonattainment areas along shipment routes are well below the EPA threshold emission levels, and thus require no formal conformity analysis. The deduction is made that the Paducah Site's proposed action of similar shipments per year along the same routes would also be de minimus.

Socioeconomics and environmental justice. The processing and repackaging of affected wastes for shipment are expected to result in an increase of 30 full-time-equivalent jobs per year. Transportation employment would similarly create 15 or fewer full-time-equivalent jobs. An increase of 45 total jobs would represent less than a 1% change from 1997 employment in McCracken County, which does not constitute a notable impact. Because the actual employment impact is likely to be smaller and would be spread over additional counties, there would be no notable economic impact from the proposed action. For the treatments considered in this EA, populations considered under environmental justice guidance are those that live within 80 km (50 miles) of the Paducah Site. However, these groups would be subject to the same negligible impacts as the general population.

Irreversible and Irretrievable Commitment of Resources. The proposed action would result in the decrease of the irreversible and irretrievable use of necessary fuel, power, and materials for maintaining the wastes and the storage facilities. No new storage facilities would be constructed. Funding could eventually be decreased for the management of wastes and facilities since the waste volume would decrease.

Cumulative Effects. Implementation of the proposed action would decrease the current risks for exposure of workers, the public and ecological resources to radiological emissions and nonradiological contaminants because it would decrease the amount of wastes present at the site.

NO ACTION ALTERNATIVE

Radiological Risks. Worker doses under the No Action alternative would result in less than 1 Latent Cancer Fatality per waste type based on a worker population of 30 full-time employees. The estimated radiological doses are highly conservative because the calculations assumed that workers would spend the entire workday in the waste storage areas, which is not likely.

The potential for public exposure to radiological emissions resulting from LLW and TRU waste management activities under the No Action alternative is limited at the Paducah Site. It is unlikely that routine waste management activities would result in measurable quantities of radiation at the Paducah Site boundaries. A perimeter-monitoring program and warning system are in place around the Paducah Site boundaries and elsewhere to evaluate impacts from routine operations as well as emergency conditions. There are off-site regulatory limits that are adhered to by the Paducah Site as well. Environmental monitoring activities are conducted routinely and reported in the Annual Environmental Monitoring Report. This report has not indicated any adverse impact from the Paducah Site operations that include waste management activities. Therefore, it is unlikely that the No Action alternative would impact the public above current levels in terms of radiological impacts from continued storage of LLW and TRU waste.

Nonradiological Risks. Continued storage of LLW and TRU waste at the Paducah Site under the No Action alternative would increase safety risks to workers by requiring additional handling of the waste as maintenance and repackaging activities are needed. In addition, there would be routine monitoring activities in the storage locations that can present typical safety risks. These risks have been evaluated based on the average industrial accident rates for operations at similar industries. The estimated number of total recordable cases for the 30 workers associated with the No Action alternative would be 0.78 cases per year. The estimated lost workdays (LWDs) due to occupational illness or injury would be approximately 11 per year. In addition, as waste inventories grow over time, additional storage facilities or expansion of current capacity would be needed. This would require the use of heavy equipment and would introduce accident risks during facility construction.

Accident Analysis. The EBE and vehicle impact/mishandling accidents were evaluated for the No Action alternative. Because the waste characteristics and the accident scenarios are the same as those evaluated for the proposed action, the accident consequences are identical to the proposed action. However, while the frequency of the earthquake accident is the same for both alternatives, the frequency of vehicle impact/mishandling accidents is much lower due to the lower activity level. Based on the revised accident frequencies under the No Action alternative, expected fatalities are less than for the proposed action. However, because the institutional control period is assumed to be 100 years under the No Action alternative and is only 10 years under the proposed action, fatalities from the EBE increase by a factor of 10 under the No Action alternative. However, in both cases, the calculated number of expected fatalities remains negligible under the No Action alternative.

Ecological resources.

Aquatic Biota – Short- and long-term impacts to aquatic resources resulting from normal operations of the No Action alternative would be similar to those currently occurring from the Paducah Site activities. Accident impacts to resources from the worst-case accident scenario (i.e., earthquake) involving radionuclides should be no different from impacts associated with the proposed action. The earthquake scenario is highly unlikely to cause harm to aquatic biota in the Ohio River as a result of exposure to radionuclides. However, just as with the proposed action, aquatic receptors in Bayou and Little Bayou creeks and other water conveyances by which the waste would reach the Ohio River would likely be affected by the caustic nature of the waste. Accident impacts to resources from the worst-case accident scenario (i.e., earthquake) involving nonradionuclides are the same as for the proposed action. PCBs could pose minor, short term adverse impacts to aquatic biota in the Ohio River, as well as in Bayou and Little Bayou creeks. None of the other nonradionuclide contaminants would reach concentrations in the Ohio River to pose adverse impacts to aquatic biota.

Terrestrial Biota – Short- and long-term impacts to terrestrial biota from normal operations of the No Action alternative should be similar to those currently occurring from the Paducah Site activities. Impacts to terrestrial biota from the modeled worst-case spill accident scenario (i.e., earthquake) are the same as for the proposed action. Just as for the proposed action, long-term radiation effects to soil biota as the result of an earthquake would be negligible. Accident impacts to terrestrial biota from the worst-case accident scenario (i.e., earthquake) involving nonradionuclides would likely pose adverse impacts to soil biota under the No Action alternative.

Noise. Noise levels would be similar to those currently at the site since the activities included under the No Action Alternative are already being conducted on the site. If construction of new storage facilities is required, noise levels in the vicinity of the construction would increase during the construction period.

Air quality. The No Action alternative would not alter air quality at the Paducah Site or in the surrounding region since the activities included in this alternative are already being conducted at the site.

Socioeconomics and environmental justice. The No Action alternative would result in no net change in employment and therefore would have no notable socioeconomic impact on the ROI. Impacts from noise, air emissions, radiological emissions, and accidents would be low for both the residents closest to the site and the low-income communities. Exposures for the general public and the relevant workers would continue at historical levels for the Paducah Site.

Irreversible and Irretrievable Commitment of Resources. The no action alternative would result in the irreversible and irretrievable use of necessary fuel, power, and materials for maintaining the wastes and the storage facilities. If new storage facilities are constructed, additional building materials and energy would be used. Additional funding would be required for managing the increasing volumes of wastes and new facilities.

Cumulative Effects. Implementation of the no action alternative would add incrementally to current risks for exposure of workers, the public and ecological resources to radiological emissions and nonradiological contaminants because it would increase the amount of wastes present at the site.

ENHANCED STORAGE ALTERNATIVE

Radiological Risks. Worker doses under the No Action alternative would result in less than 1 LCF per waste type based on a worker population of 30 full-time employees. These doses would remain the same under the Enhanced Storage alternative because the work force required for storage facility workers would remain the same. The potential for public exposure to radiological emissions resulting from LLW and TRU waste management activities under the No Action alternative is limited at the Paducah Site. This potential would be further reduced under the Enhanced Storage alternative because the new/upgraded facilities would provide additional confinement to reduce the potential for radiological materials releases. Therefore, it is unlikely that the Enhanced Storage alternative would impact the public above current levels in terms of radiological impacts from continued storage of LLW and TRU waste.

Nonradiological Risks. Continued storage of LLW and TRU waste at the Paducah Site under the No Action alternative would increase safety risks to workers by requiring additional handling of the waste as maintenance and repackaging activities are needed. In addition, there would be routine monitoring activities in the storage locations that can present typical safety risks. These risks have been evaluated based on the average industrial accident rates for operations at similar industries. The estimated number of total recordable cases for the 30 workers associated with the No Action alternative would be 0.78 cases per year. The estimated lost workdays (LWDs) due to occupational illness or injury would be approximately 11 per year under the No Action alternative. These risks would remain the same under the Enhanced Storage alternative.

Accident Analysis. Under the Enhanced Storage alternative, the packaged waste containers would be transported to an on-site location and stored. The containers would be inspected periodically to verify that the containers are intact and repaired if required. These containers would be subject to the same conditions as the stored containers in the proposed action. They would, however, be at risk for a longer period of time. The EBE and vehicle impact/mishandling accidents were evaluated. The waste characteristics and the accident scenarios are the same for the Enhanced Storage alternative as those evaluated for the No Action alternative; however, the accident consequences would be expected to be less for the EBE because the enhanced storage facilities would provide additional confinement, thus reducing the amount of material released outside the building. The frequencies for both accidents remain the same as the No Action alternative.

Comparison of Accident Risks. Risks were computed for both process accidents and industrial accidents for the proposed action and the No Action alternatives. The highest radiological accident risk was 1.5×10^{-7} expected fatalities for the maximally exposed involved worker (MIW) and MUW at the edge of the waste storage area during and following an earthquake. This risk would be expected to be at least a factor of ten lower for the Enhanced Storage alternative because the buildings would provide additional confinement to reduce releases outside the facility. This risk would be computed for the 100-year no-action and enhanced storage institutional period. The second highest risk, 7.9×10^{-8} expected fatalities, was computed for the vehicle impact/mishandling accident impacting the ThF_4 container during the 10-year proposed action operating period. The risks are the same for all three alternatives, but the proposed action has a shorter duration.

The calculated industrial accident risks, while higher than the radiological accident risks, were small. The computed risk for the proposed action was 0.02 expected fatalities over the 10-year operating period. The corresponding industrial accident risk for the No Action alternative was 0.1 expected fatalities over the 100-year institutional control period and would be the same for the Enhanced Storage alternative. Neither the risks nor the differences between them are considered notable.

Ecological resources.

The Enhanced Storage alternative would not adversely affect any threatened or endangered species.

Aquatic Biota - Short- and long-term impacts to aquatic biota from the Enhanced Storage alternative would be no greater than those currently occurring from the Paducah Site activities. Accident impacts to aquatic biota from the worst-case accident scenario (i.e., earthquake) involving radionuclides were described for the proposed action, and the impacts should be no greater for the Enhanced Storage alternative. Because of this, the earthquake scenario is highly unlikely to cause harm to aquatic biota in the Ohio River as a result of exposure to radionuclides. However, just as with the proposed action, aquatic receptors in Bayou and Little Bayou creeks and other water conveyances by which the waste would reach the Ohio River would likely be less affected under the Enhanced Storage alternative because less radioactive materials would escape from the storage facilities.

Nonradionuclide accident impacts to aquatic biota from the worst-case accident scenario (i.e., earthquake) were also described for the proposed action. Again, the impacts should be no greater for the Enhanced Storage alternative. PCBs could pose adverse impacts to aquatic biota in the Ohio River, as well as in Bayou and Little Bayou creeks. None of the other nonradionuclide contaminants would reach high enough concentrations in the Ohio River to pose adverse impacts to aquatic biota.

Terrestrial Biota - Short- and long-term impacts to terrestrial biota from the Enhanced Storage alternative should be no greater than those currently occurring from the Paducah Site activities. Impacts to terrestrial biota from the modeled worst-case spill accident scenario (i.e., earthquake) are no greater than for the proposed action. Just as for the proposed action, long-term radiation effects to soil biota as the result of an earthquake would be negligible under the Enhanced Storage alternative. Accident impacts to terrestrial biota from the worst-case accident scenario (i.e., earthquake) involving nonradionuclides under the proposed action were described. The impacts to terrestrial biota under the Enhanced Storage alternative should be less. Nonradionuclides would likely pose less impact to biota if the worst-case spill accident occurred under the Enhanced Storage alternative because less material would escape from the storage facilities.

Air quality. Under the Enhanced Storage alternative, potential impacts resulting from on-site treatment, transport, and disposal would not apply. Other potential impacts would be no greater than those identified for the proposed action.

Socioeconomics and environmental justice. The Enhanced Storage alternative may result in a slight increase in employment due to construction and/or upgrades required for storage facilities. In addition, long-term surveillance and maintenance of facilities designed to withstand increased EBE loads might result in additional staff. Impacts from noise, air emissions, radiological emissions, and accidents would be low for both the residents closest to the site and the low-income communities. Exposures for the general public and the relevant workers would be no greater than those at historical levels for the Paducah Site

Irreversible and Irretrievable Commitment of Resources. The Enhanced Storage alternative would result in the irreversible and irretrievable use of necessary fuel, power, and materials for maintaining the wastes and building the enhanced storage facilities. New storage facilities would be constructed and additional building materials and energy would be used. Additional funding would be required for building facilities and managing the increasing volumes of wastes and new facilities.

Cumulative Effects. Implementation of the Enhanced Storage alternative would add incrementally to current risks for exposure of workers, the public and ecological resources to radiological emissions and nonradiological contaminants because it would increase the amount of wastes present at the site.

DETERMINATION: Based on the findings of this EA, DOE has determined that the proposed action does not constitute a major federal action that would significantly affect the quality of the human environment within the context of the National Environmental Policy Act. Therefore, preparation of an environmental impact statement is not required.

Issued at Oak Ridge, Tennessee, this 5th day of November 2002.

James A. Turi

James A. Turi
Acting Manager
U.S. Department of Energy
Oak Ridge Operations
Oak Ridge, Tennessee

DOE/EA-1339
FINAL

Final Environmental Assessment for Waste Disposition Activities at the Paducah Site Paducah, Kentucky

Date Issued—November 2002

U.S. Department of Energy
Office of Environmental Management

00-347(doc)/071702

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FIGURES

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ACRONYMS

AST	airborne source term
BCK	Bayou Creek kilometer
BJC	Bechtel Jacobs Company, LLC
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR	*Code of Federal Regulations*
COE	U.S. Army Corps of Engineers
CX	categorical exclusion
D&D	decommissioning and decontamination
DCG	derived concentration guide
DMSA	DOE Material Storage Area
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
EA	environmental assessment
EBE	evaluation-basis earthquake
EPA	U.S. Environmental Protection Agency
ESD	Environmental Sciences Division
ETTP	East Tennessee Technology Park
FFCA	Federal Facility Compliance Agreement
FWS	U.S. Fish and Wildlife Service
HC1	hydrochloric acid
HDDV	heavy duty diesel-powered vehicle
HEPA	high-efficiency particulate air
IDLH	immediately dangerous to life or health
KAR	*Kentucky Administrative Regulations*
KDEP	Kentucky Department for Environmental Protection
KDFWR	Kentucky Department of Fish and Wildlife Resources
KPDES	Kentucky Pollutant Discharge Elimination System
KSNPC	Kentucky State Nature Preserves Commission
LCD	Lower Continental Deposits
LCF	latent cancer fatality
LDR	land disposal restriction
LLW	low-level radioactive waste
LST	liquid source term
LUK	Little Bayou Creek kilometer
LWD	lost workdays
MEI	maximally exposed individual (off-site individual at site boundary)
MEWC	Materials & Energy/Waste Control Specialists
MIW	maximally exposed involved worker
MLLW	mixed low-level waste
MSL	mean sea level
MUW	maximally exposed uninvolved worker
NAAQS	National Ambient Air Quality Standards
NCS	Nuclear Criticality Safety
NEPA	National Environmental Policy Act of 1969
NRC	U.S. Nuclear Regulatory Commission
ORNL	Oak Ridge National Laboratory
Paducah Site	Paducah Gaseous Diffusion Plant Site

PCB	polychlorinated biphenyl
PPE	personal protective equipment
PSD	prevention of significant deterioration
RCRA	Resource Conservation and Recovery Act of 1976
RGA	Regional Gravel Aquifer
ROD	Record of Decision
ROI	region of influence
RPCB	radiological polychlorinated biphenyl
SIP	state implementation plan
STP	Site Treatment Plan
TRE	toxicity reduction evaluation
TRU	transuranic
TSCA	Toxic Substances Control Act of 1976
TVA	Tennessee Valley Authority
UCD	Upper Continental Deposits
UCRS	Upper Continental Recharge System
USEC	United States Enrichment Corporation
WIPP	Waste Isolation Pilot Plant
WKWMA	West Kentucky Wildlife Management Area
WM-PEIS	Waste Management Programmatic Environmental Impact Statement
WWTP	wastewater treatment plant

1. INTRODUCTION

The U.S. Department of Energy (DOE) proposes disposition activities for polychlorinated biphenyl (PCB) wastes, low-level radioactive waste (LLW), mixed low-level radioactive waste (MLLW), and transuranic (TRU) waste from the Paducah Gaseous Diffusion Plant Site (Paducah Site) in Paducah, Kentucky (Table 1.1). All of the wastes would be transported for disposal at various locations in the United States. As a federal agency, DOE must comply with the National Environmental Policy Act of 1969 (NEPA) by considering, in the decision-making process, potential environmental impacts associated with its proposed action. The Council on Environmental Quality (CEQ) promulgated regulations to implement NEPA [40 *Code of Federal Regulations* (*CFR*) 1500 et seq.] and directed federal agencies to develop their own implementing regulations. DOE regulations (10 *CFR* 1021) provide additional direction for conducting NEPA reviews of proposed DOE activities. This environmental assessment (EA) for the disposition of various DOE wastes stored and/or generated at nonleased portions of the Paducah Site has been prepared in accordance with both CEQ and DOE regulations and with DOE orders and guidance regarding these waste types.

Table 1.1. Paducah EA waste information

Waste type	Approximate total volume (m^3, unless noted otherwise)	Proposed treatment		Proposed disposal		Approximate volume to be shipped (m^3)
		On-site	Off-site	On-site	Off-site	
PCB	128 metric tons		X		X	200
LLW (T-Hoppers)	22 units					
LLW	5,000	X		~~X~~	X	4,950
MLLW	5,700	X	X	~~X~~	X	5,800
TRU	6	X			X	12

EA = environmental assessment
LLW = low level radioactive waste
MLLW = mixed low level waste
PCB = polychlorinated biphenyl
TRU = transuranic

1.1 PURPOSE AND NEED FOR AGENCY ACTION

DOE must continue to manage (i.e., treat, store, and dispose) and control its wastes safely, efficiently, and cost effectively in compliance with applicable federal and state laws and protecting public health and the environment.

DOE is under regulatory agreements to treat and dispose several waste types. Regulatory agreements pursuant to the Resource Conservation and Recovery Act of 1976 (RCRA) and the Toxic Substances Control Act of 1976 (TSCA) require that DOE develop waste treatment options to meet required schedules.

DOE developed a site treatment plan (STP) for MLLW, as required by the Federal Facility Compliance Act of 1992. The Commonwealth of Kentucky approved the STP, and the Agreed Order was signed on September 10, 1997. The STP Agreed Order supercedes the Federal Facility Compliance Agreement (FFCA) for land disposal restrictions (LDRs) between DOE and the U.S. Environmental Protection Agency (EPA) (referred to as the LDR FFCA). The STP requires that DOE characterize MLLW and RCRA/TSCA-regulated mixed waste streams and develop and implement a plan for their treatment.

The TSCA FFCA, which DOE entered into with EPA in 1992, establishes requirements for compliance with TSCA. DOE developed a TSCA Implementation Plan for the Paducah Site to ensure compliance with the TSCA FFCA requirements. Both the TSCA FFCA and the TSCA Implementation Plan for the Paducah Site have requirements for the disposal of TSCA-regulated, TSCA-regulated mixed, and RCRA/TSCA-regulated mixed wastes. The TSCA FFCA requires that disposal of these wastes begin as soon as EPA approves a disposal method. Moreover, it requires that such wastes generated after 1992 be disposed within 10 years of their generation date.

DOE is required by the Atomic Energy Act (42 United States Code 2011 et seq.) and DOE Order 435.1 to manage the radioactive wastes that it generates. DOE has determined that it will dispose LLW and MLLW at the Hanford Site in Washington state and at the Nevada Test Site, as documented in the *Record of Decision (ROD) for the Department of Energy's Waste Management Program: Treatment and Disposal of Low-Level Waste and Mixed Low-Level Waste* (January 1998, 63 Federal Register 3629). Generally, the proposed action would aid implementation of the high tier NEPA documentation and RODs. Pertinent documents are presented in Tables 1.2 and 1.3.

There are 160 DOE Material Storage Areas (DMSAs) at the Paducah Site. DOE needs to characterize the materials in the DMSAs consistent with RCRA/TSCA regulations and Nuclear Criticality Safety requirements. DOE has prepared the Paducah Gaseous Diffusion Plant Department of Energy Material Storage Area Characterization Remediation Plan (BJC 2001). This document outlines activities for the characterization of wastes managed in the 160 DMSAs.

As described above, DOE-Oak Ridge Operations has various waste types located at the Paducah Site that must undergo disposition activities. In this anlaysis, disposition activities include any activity, primary or supporting, needed to effectively manage Paducah Site wastes. Examples of primary disposition activities include waste storage, on-site and/or off-site treatment, transportation, and disposal. Supporting activities may include vehicle fueling, facility maintenance, staging, packaging, sorting, volume reduction, storage container inspections, etc.

1.2 SCOPE OF THIS ASSESSMENT

In October 1992, Congress passed the Energy Policy Act of 1992, which established the U.S. Enrichment Corporation (USEC). Effective July 1, 1993, DOE leased the plant production operation facilities to USEC. Under the terms of the lease, USEC assumed responsibility for environmental compliance activities that were directly associated with uranium enrichment operations. Generally, DOE retained responsibility for the site environmental restoration program and the legacy waste management program, including waste inventories predating July 1, 1993, and wastes generated by ongoing DOE activities.

This EA provides an evaluation of the potential effects of disposition of accumulated legacy and ongoing operational wastes at the Paducah Site. The potential effects of waste transportation over both highway and rail routes are evaluated. It should also be noted that the 10-year waste disposition assumptions result in a baseline disposal time frame and produce a reasonable "worst-case" scenario for risk analysis. This assumption does not imply that risks are eliminated after the 10-year period. It is anticipated that as long as newly generated waste does not exceed the contaminant concentration assumptions made in the risk impact analysis and volume parameters presented in Table 1.1, this document would apply past the 10-year time frame. This is reasonable, because the impact analysis for any newly generated wastes that match the waste parameters would be very similar to those presented within this document. If ongoing operations produce a waste that differs from the wastes described herein, additional NEPA review may be required. Wastes not considered part of the proposed action and alternative include waste for which treatment and disposal are addressed pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA). CERCLA wastes are the primary wastes (by volume) at the Paducah Site. NEPA values for these wastes are addressed in project-specific CERCLA documents. Additionally, the cumulative impacts section of this document takes CERCLA wastes into consideration.

Table 1.2. Additional DOE documents addressing Paducah Site wastes

Waste Type	Activity	Proposed action	Documents providing analysis/decisions								
			NEPA					Record of decision			
			This document	WM PEIS	WIPP EIS	TRU EIS	Facility documents	65-FR-10061	63-FR-3629	65-FR-82985	65-FR-48683
Mixed low-level waste	Storage	On-site	X[1]	X							
	Transport to treatment	NA	–	–	–	–	–	–	–	–	–
	Treatment	On-site as consistent with STP	X[2]	X				X			
	Transport	Truck transport	X								
	Disposal	Commercial	X[3]				X	X			
Low-level waste (solids)	Storage	On-site	X[1]	X							
	Transport to treatment	NA	–	–	–	–	–	–	–	–	–
	Treatment	NA	–	–	–	–	–	–	–	–	–
	Transport	Truck transport	X								
	Disposal	NTS		X			X	X			
Wastewater	Storage	On-site	X								
	Transport to treatment	NA	–	–	–	–	–	–	–	–	–
	Treatment	On-site	X								
	Transport	NA	–	–	–	–	–	–	–	–	–
	Disposal	NA	–								
TRU waste	Storage	On-site	X[1]	X					X		
	Transport to treatment	NA	–	–	–	–	–	–	–	–	–
	Treatment	On-site	X[2]	X					X		X
	Transport to staging	Truck transport to ORNL	X								
	Transport to disposal	Truck transport from ORNL to WIPP				X					
	Disposal	WIPP		X	X		X			X	
PCB waste	Storage	On-site	X								
	Transport to treatment	NA	–	–	–	–	–	–	–	–	–
	Treatment	NA	–	–	–	–	–	–	–	–	–
	Transport	Truck transport	X								
	Disposal	Deer Park	X[3]				X				

Table 1.2. Additional DOE documents addressing Paducah Site wastes (continued)

[1] Current inventory impacts were assessed under the WM-PEIS. Ongoing operations impacts are addressed in the waste EA.
[2] Although the basic concept of this activity was addressed in the WM-PEIS, the specific process that would be implemented at the site is addressed in the waste EA.
[3] Qualitative analysis performed in the waste EA.
– = not applicable
FR = Federal Register
NA = not applicable
NTS = Nevada Test Site
ORNL = Oak Ridge National Laboratory
PCB = polychlorinated biphenyl
STP = Site Treatment Plan
TRU = transuranic
WIPP = Waste Isolation Pilot Plant
WM-PEIS = Waste Management Programmatic Environmental Impact Statement

REFERENCES:

WM-PEIS = Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste. DOE/EIS-0200-F, May 1997.

WIPP EIS = Final Environmental Impact Statement for the Waste Isolation Pilot Plant, DOE/EIS-0026, October 1980.

TRU EIS = Final Environmental Impact Statement for Treating Transuranic (TRU)/Alpha Low Level Waste at the Oak Ridge National Laboratory, Oak Ridge, Tennessee, DOE/EIS-0305-F, June 2000.

Waste EA = This document.

65-FR-10061 = Record of Decision for the Department of Energy's Waste Management Program: Treatment and Disposal of Low-Level Waste and Mixed Low-Level Waste; Amendment of the Record of Decision for the Nevada Test Site, February 2000.

63-FR-3629 = Record of Decision for the Department of Energy's Waste Management Program: Treatment and Storage of Transuranic Waste, January 1998.

65-FR-82985 = Revision to the Record of Decision for the Department of Energy's Waste Management Program: Treatment and Storage of Transuranic Waste, December 2000.

65-FR-48683 = Record of Decision on Treating Transuranic (TRU)/Alpha Low-Level Waste at the Oak Ridge National Laboratory, August 2000.

63-FR-41810 = Record of Decision for the Department of Energy's Waste Management Program: Treatment of Non-wastewater Hazardous Waste, August 1998.

Table 1.3. Summary of Waste Management PEIS Record of Decisions (ROD) Issued to Date for Paducah Site Waste Types

Waste Type	Activity	ROD(s)	Decision	Rationale
Mixed Low Level Waste	Treatment	65 FR 10061	Treat at Hanford, INEEL, ORR and SRS or onsite as consistent with current STP.	Takes advantage of infrastructure capabilities that already exist. Also avoids environmental impacts and costs associated with construction of new facilities.
	Disposal	65 FR 10061	Dispose at Hanford or NTS. Decision does not preclude DOE's use of commercial disposal facilities consistent with current DOE policy.	Based on low impacts to human health, operational flexibility, and relative implementation costs. No foreseeable need for construction of a third facility due to volume of waste anticipated.
Low Level Waste	Treatment	65 FR 10061	Perform minimal treatment at the site.	Volume reduction would not offer sufficient benefits to offset the increase in human health effect and costs it would entail.
	Disposal	65 FR 10061	Offsite disposal at Hanford, NTS, or commercal facility. Potential continued on-site disposal at LANL, SRS, INEEL, and ORR.	Based on low impacts to human health, operational flexibility, and relative implementation costs.
Transuranic Waste	Treatment	63 FR 3629	May decide to ship TRU wastes from sites for preparation and disposal.	It may be impractical for sites with small amounts of TRU wastes to develop capabilities to prepare them for disposal. It would be more cost effective to transfer them to sites where DOE has the existing capability. The sites that could receive such shipments include the ORR.
	Storage	63 FR 3629	Prepare and store its TRU waste on site.	On site storage results in the lowest impacts among the alternatives analyzed in the WM PEIS.
	Treatment (revised)	65 FR 82985	Develop capability at WIPP to prepare TRU waste for disposal.	Revision of earlier ROD to create a centralized capability to dispose of TRU waste at WIPP. This would expedite the removal of waste from sites with smaller inventories of TRU wastes.
	Storage (revised)	65 FR 82985	Increase above ground storage time at WIPP to 1 year and the total above-ground storage capacity increased by 25%.	Allows DOE to accumulate the necessary amount of waste for approval of the program by EPA and NMED. Also allows to store wastes during disposal delays.
Non-wastewater Hazardous Waste	Treatment	63 FR 41810	Continue to use off-site facilities for the treatment of major portions of this waste.	The potential health, environmental, and cost impacts of continued use of off-site commercial facilities are low. The additional costs of expanding existing facilities and/or constructing new ones is not justified in view of commercial facility availability.
	Disposal	63 FR 41810	Continue to use off-site facilities for the disposal of major portions of this waste.	Upon receipt of wastes for treatment, the facility takes title to the wastes and, after treatment, dispose of it.
PCB Waste	Treatment	None	None	None
	Disposal	None	None	None

Current typical disposition activities include actions taken to maintain and/or manage Paducah Site wastes. These include, but are not limited to, the following: storage, drum movement, overpackaging/repackaging, equipment and drum sorting and flushing, physical volume reduction, equipment and waste-container decontamination, marking, relabeling, inspection, drip/spill cleanup, waste tracking, and inventory. Other activities include standard waste characterization (which includes waste sampling), waste analysis and data management, waste treatment and disposal, and miscellaneous supporting activities. Minor facility modifications/upgrades, for example, new alarm systems, would be made as necessary.

This assessment also presents the most current waste volumes for Environmental Management Program wastes at the Paducah Site (Table 1.1). Changes from the previous forecast have resulted from waste-minimization and pollution-prevention efforts on the Paducah Site, coupled with changes in operational plans. Therefore, there has been a decrease in the forecasted volumes of various waste streams that would be generated. If this trend continues, it would result in lower anticipated impacts and risks in the future.

This environmental assessment is tiered under other currently existing NEPA documents. Generally, DOE site-specific NEPA documents are tiered under DOE programmatic NEPA documents. Therefore, analysis performed and decisions made in programmatic documents do not have to be repeated for similar site-specific actions.

This assessment is intended to supplement and update the previous NEPA evaluation of waste disposition activities conducted as part of the final Waste Management Programmatic Environmental Impact Statement (WM-PEIS) for radioactive and hazardous waste (DOE 1997). This assessment expands the scope of previous analyses to include possible transportation to commercial facilities. Tables 1.2 and 1.3 provide a summary of analyses performed for Paducah wastes in other NEPA documents. These tables also provide a summary of decisions made in applicable record-of-decision documents.

A public information meeting was held on October 26, 2000, in which DOE sought input on the contents of this EA. Some comments were in opposition to any new on-site landfills for waste disposal, and some people expressed concern about incineration as a treatment option at any site. No new landfills are proposed for this action. Some MLLW is proposed for off-site treatment at the TSCA Incinerator in Oak Ridge, Tennessee. Residual wastes from incineration will be dispositioned in accordance with TSCA Operating Procedures and the TSCA Incinerator Residual Management Plan. Appendix B presents a distribution list of individuals who received this document.

The wastes considered in this assessment are limited to DOE's ongoing and legacy non-CERCLA waste management operations at the Paducah Site. These wastes include LLW, MLLW, and TRU waste, as well as materials stored in DMSAs. Also included is storage of USEC program wastes, which are characterized as one or more of these waste types.

Wastes not covered in this EA are those associated with CERCLA activities, including decontamination and decommissioning activities, and disposal of wastes associated with USEC uranium enrichment activities.

Environmental impacts from the disposal and/or treatment of waste at DOE facilities have been evaluated as part of the NEPA documents associated with ongoing facility operations. The EA does not include detailed consideration of impacts from treatment and disposal operations at commercial facilities. Per DOE guidance, while analysis of impacts from a vendor's action may be within the scope of DOE's review obligation, "the level of detail should be commensurate with the importance of the impacts or issues related to the impacts. If DOE's proposed waste load would be a small part of the facility's throughput and the facility would operate well within established standards, then the vendor's part of DOE's proposal would be low on the *sliding (sic)* scale, and a statement of this context would adequately characterize the impacts" (DOE 2000d, *"Lessons Learned"*). Waste volumes anticipated over a 10-evaluation period comprise, or would comprise, less than 1 percent of the combined capacity of the commercial treatment and/or disposal facilities and less than 4 percent of the capacity of any one individual commercial facility. The commercial treatment and disposal facilities that will be used to treat or dispose the waste are required to operate within the bounds of federal and state requirements such as U.S. Nuclear Regulatory Commision (NRC) or Agreement State licenses, RCRA permits, TSCA authorizations, air and water permits, and Occupational Safety and Health Administration regulations. Also, the waste planned to be transported is typical of waste being treated at the commercial waste treatment facilities.

There are three other environmental and waste management activities associated with the Paducah Site that are not covered by CERCLA or this EA: (1) the depleted uranium hexaflouride conversion project, (2) the disposal of nonradioactive waste containing residual radioactivity at the C-746-U landfill, and (3) DOE's proposal to implement a long-term management plan for its inventory of potentially reusable low-enriched uranium. DOE is currently in the process of preparing appropriate NEPA reviews for all of these activities.

1.2.1 PCB Waste

Polychlorinated biphenyls (PCBs) are mixtures of synthetic organic chemicals with the same basic chemical structure and similar physical properties, ranging from oily liquids to waxy solids. Due to their nonflammability, chemical stability, high boiling point, and electrical insulating properties, PCBs are used in hundreds of industrial and commercial applications, including electrical, heat transfer, and hydraulic equipment; as plasticizers in paints, plastics, and rubber products; in pigments, dyes, and carbonless copy paper; and in many other applications.

1.2.2 Low-Level Waste

LLW is radioactive waste that is not high-level radioactive waste, spent nuclear fuel, TRU waste, byproduct material (as defined in section 11e.(2) of the *Atomic Energy Act of 1954,* as amended), or naturally occurring radioactive material (DOE G 435.1-1).

1.2.3 Mixed Low-Level Waste

MLLW is waste that contains LLW (as defined above) and hazardous waste. Hazardous wastes are a subset of solid wastes that pose substantial or potential threats to public health or the environment and meet any of the following criteria identified by 40 *CFR* 260 and 261:

- they are specifically listed as a hazardous waste by EPA,
- they exhibit one or more of the characteristics of hazardous waste (ignitability, corrosiveness, reactivity, and/or toxicity),
- they are generated by the treatment of hazardous waste, or
- they are contained in a hazardous waste.

1.2.4 TRU Waste

TRU waste contains, for each gram of waste, more than 100 nanocuries of alpha-emitting TRU isotopes, with half-lives greater than 20 years. A waste can meet this definition without being considered TRU waste if it is (1) high-level radioactive waste; (2) waste that DOE has determined, with the concurrence of EPA, does not need the degree of isolation required by EPA's high-level waste rule (40 *CFR* 191); or (3) waste that has been approved for disposal on a case-by-case basis in accordance with the NRC's radioactive land disposal regulation (10 *CFR* 61). TRU is not generally found outside the DOE complex and is produced mainly from the reprocessing of spent nuclear fuel, nuclear weapons production, and reactor fuel assembly. TRU wastes emit mainly alpha particles as they break down.

1.2.5 DMSA Waste

DMSA wastes are located throughout the Paducah Site. These storage areas (approximately 160 of them) are located within buildings and areas that have been leased to USEC. Detailed descriptions of DMSA waste are not available because the majority of it has not been characterized. However, based upon visual surveillance, the majority of this waste appears to be discarded furniture, equipment, and assorted rubble. After the materials in these areas are characterized, any RCRA/TSCA/solid waste that is identified would be grouped and properly dispositioned as the waste types listed in this section. Other DMSA waste types would remain in storage until they are evaluated during CERCLA-related decommissioning and decontamination (D&D) activities.

2. PROPOSED ACTION AND ALTERNATIVES

2.1 PROPOSED ACTION

DOE proposes to disposition site wastes as needed. For the purpose of this EA, disposition activities are defined as any actions taken to maintain and/or manage Paducah Site wastes. Disposition activities may include characterization, storage, packaging, treatment, loading, and shipping existing and forecasted Paducah Site wastes to treatment/disposal locations. For analysis purposes, Table 1.1 presents typical Paducah Site wastes and approximate volumes. Mitigations and best management practices may be applied for each disposition activity. Mitigations are identified in Chap. 4. Approximated waste volumes for each of the following activities include anticipated quantities of postcharacterized DMSA wastes.

2.1.1 Storage

Under the proposed action, all waste would be stored at the Paducah Site until it is scheduled for treatment, disposal, or transport from the Paducah Site. Existing facilities would be used for waste storage. At this time, it is not anticipated that any new waste storage facilities would be constructed. DMSA wastes that are not characterized as RCRA/TSCA waste would remain in storage until analyzed during D&D CERCLA actions.

2.1.2 On-Site Treatment

On-site treatment applies to approximately 200 m^3 (7060 ft^3) of the approximate 11,000 m^3 (390,000 ft^3) non-PCB waste volume covered in this EA, which includes up to 120 m^3 (4238 ft^3) of MLLW solids, 12 m^3 (424 ft^2) of ^{99}Tc-contaminated MLLW, and 6 m^3 (211 ft^3) of TRU waste. On-site treatment technologies are limited by the Paducah Site RCRA Part B permit. RCRA-permitted on-site treatment technologies include sedimentation, precipitation, oxidation, reduction, neutralization, and cementation/solidification. Currently, only neutralization, stabilization, carbon adsorption, and photocatalytic conversion are proposed on-site. These are the only technologies discussed in subsequent sections because they are the ones applicable to waste types presented. Building C-752-A has been proposed as the site for processing any on-site waste that needs to be treated.

Another 52 m^3 (1836 ft^3)/year of wastewater would also be treated on-site. Volumes listed are approximate. Wastewater would be treated on-site by carbon adsorption, photocatalyic conversion, and/or lime precipitation. These treatment activities would be compliant with the applicable Kentucky Pollutant Discharge Elimination System (KPDES) permit(s). Short descriptions of the proposed treatment technologies are presented in the following sections.

2.1.2.1 Neutralization

Neutralization reduces the acidity or alkalinity of hazardous wastes in a waste stream to a more neutral condition. The process consists of blending acids and bases in order to adjust the pH (a measure of acidity or alkalinity) to yield a neutral solution of salt and water. Alkaline wastes often are mixed with acid wastes, thereby neutralizing two waste streams at the same time. Neutralized waste is safer to store, transport, and dispose than acidic or alkaline waste.

2.1.2.2 Cementation/solidification

In a cementation/solidification process, some fixation renders the waste less hazardous by reducing the ability of the waste constituents to migrate. Solidification and encapsulation bind wastes into a solid mass that would not readily break down. Chemical fixation treatment methods often are employed to tie up hazardous components. These methods reduce leachability, even though the hazardous waste constituents may not be altered. Inorganic materials in aqueous solutions and suspension of metals or inorganic salts are most amenable to this technique. This process reduces mobility of the hazardous constituent or waste and makes the waste easier to handle. The most common stabilization agents added to the waste streams are Portland cement, lime, fly ash, and cement kiln dust.

A portion of the MLLW streams would be treated by on-site or off-site stabilization (Table 1.1). Approximately 10 m^3 (353 ft^3) of TRU liquids and solids would be treated on-site by solidification.

2.1.2.3 Carbon adsorption

Carbon adsorption is a process that uses activated carbon to adsorb hazardous waste constituents. Upon contact with waste containing soluble organic materials, granular activated carbon selectively removes these materials by adsorption. Adsorption is the phenomenon whereby molecules adhere to a surface with which they come into contact, due to forces of attraction at the surface.

Only the wastewater stream, consisting of approximately 52 m^3 (1836 ft^3) of waste, may be potentially treated on-site annually by this method. The wastewater, which has some organic contamination, would be treated until KPDES limits are met; this waste would then be discharged at a permitted site outfall.

2.1.2.4 Photocatalytic conversion.

Photocatalytic conversion is a system that uses ultraviolet radiation in the presence of a catalyst to treat waste by breaking down the contaminants. Only the wastewater stream may be treated by this method. The wastewater would be tested after treatment and would then be discharged through an existing permitted outfall.

2.1.3 Off-site Treatment

DOE's proposed action for off-site treatment varies by waste type. The characteristics of the waste govern where and how each waste type may be treated. The proposed treatment scenario for each type of currently known waste is listed below.

2.1.3.1 PCB waste

Fifty metric tons of capacitors containing PCBs are proposed for shipment to Deer Park, Texas, for treatment and disposal. The capacitors would be shipped in 23 7A, Type A containers. Thirteen empty transformers weighing 78 metric tons would be shipped for off-site treatment and disposal at Deer Park, Texas, as well. These transformers contain some residual PCB contamination.

2.1.3.2 Mixed low-level waste

The approximate 5700 m^3 (201,294 ft^3) of MLLW addressed in this proposed action represents a very heterogeneous grouping of wastes; most of this waste would be treated and disposed at various off-site, permitted facilities. A small portion contains PCBs, metals, and organics, and it is proposed that they be treated at the DOE TSCA Incinerator in Oak Ridge, Tennessee.

2.1.4 Waste Transport

Waste would generally be transported by truck but may also be transported by rail or intermodal carrier when advantageous. Figures 3.2 through 3.13 in Chap. 3 of this document depict the most direct representative truck and rail routes. Intermodal options are too numerous to present but could be used to comply with state requirements and stakeholder requests. Characterized DMSA wastes would be transported with similar wastes described herein.

2.1.5 Waste Disposal

All wastes are proposed to be disposed offsite. DOE's proposed action for waste disposal varies by waste type. The characteristics of the waste govern where and how each waste type may be disposed. The volume of wastes to be transported from the Paducah Site to each proposed receiving facility represents only a small portion of the total waste each facility receives annually. The proposed action for each waste type is listed below.

2.1.5.1 PCB wastes

Fifty metric tons of capacitors containing PCBs are proposed for shipment to Deer Park, Texas, for treatment and disposal. The capacitors would be shipped in 23 7A, Type A containers. Thirteen empty transformers weighing 78 metric tons would be shipped for off-site treatment and disposal at Deer Park, Texas, as well. These transformers contain some residual PCB contamination.

2.1.5.2 Low-level wastes

Approximately 4600 m^3 (162,447ft^3) of LLW would be disposed, primarily at the Nevada Test Site. In addition to these wastes, there are 22 T-Hoppers (5-ton containers) of UF_4 stored at the site. If it is determined that this material is a waste, it would likely be shipped as an LLW to the Nevada Test Site.

2.1.5.3 Mixed low-level wastes

Some MLLW would be shipped to Envirocare for treatment and disposal. The majority of this waste would be shipped to one or more of the Broad Spectrum Contractors (Waste Control Specialists LLC, Andrews, Texas; Allied Technology Group, Richland, Washington; Materials & Energy/Waste Control Specialists, Oak Ridge, Tennessee) for treatment and/or disposal.

2.1.5.4 TRU wastes

Approximately 6 m^3 of TRU liquids and solids are proposed for treatment on-site by cementation/ solidification and shipment to the TRU Waste Program at Oak Ridge National Laboratory (ORNL) for ultimate disposition. The state department of environment and conservation contends that off-site TRU waste whipments to Tennessee shall be for undelayed treatment, packaging, and shipment to the Waste Isolation Pilot Plant (WIPP) near Carlsbad, New Mexico. Impacts associated with further processing and shipment to the WIPP are addressed in the Final Environmental Impact Statement for Treating TRU and Alpha LLW (DOE 2000a).

2.1.6 Waste Disposition Supporting Activities

The proposed action for supporting waste disposition activities is to perform these activities in accordance with DOE orders, federal and state regulations, and approved Bechtel Jacobs Company, LLC (BJC) or BJC subcontractor procedures. These activities are performed mainly during waste management and maintenance at the Paducah Site. Applicable procedures are implemented to ensure that activities are performed in a safe and accountable manner. Examples of supporting activities include, but are not limited to, the following:

- waste staging,
- on-site waste movement,

- packaging/repackaging,
- sorting,
- volume reduction,
- physical,
- waste container decontamination,
- inspection,
- marking/labeling,
- characterization, and
- facility modifications or upgrades.

2.1.7 DMSA Characterization

Quantities of DMSA solid and liquid waste are stored on-site at approximately 160 locations at the Paducah Site. The DMSA waste volumes include approximately 20,000 m^3 (705,000 ft^3) of solid and liquid waste of which potentially 2.5% or approximately 500 m^3 (17,625 ft^3) could be RCRA/TSCA waste. Due to the undetermined nature of a majority of the DMSA wastes, Nuclear Criticality Safety (NCS) characterization must be performed. DOE's proposed action includes this type of characterization in addition to standard waste management operations. NCS characterization provides the information necessary to move or manage materials safely without the threat of uncontrolled nuclear criticality. NCS characterization includes the DMSA inspector's determination of the proper NCS status for items that would be based upon a review of documentation, process knowledge, and/or visual inspection. Based upon the completion of the NCS characterization, standard waste management operations would commence, including waste sampling, characterization, sorting, and movement.

2.2 NO ACTION ALTERNATIVE

In the No Action alternative (i.e., long-term storage), DOE would not perform disposition activities except for those needed for waste management and maintenance. No disposal of the existing and projected quantities of various wastes outlined in Table 1.1 and discussed under the proposed action would occur. It should be noted that the No Action alternative would not be compliant with regulatory agreements or the statutory and regulatory provisions described in Sect. 1.1. Ongoing non-CERCLA waste management operations would continue.

2.2.1 Storage

The majority of wastes discussed would remain in on-site storage and would require regular maintenance and surveillance by the Paducah Site staff. Also included under the No Action alternative would be facility upgrades and repackaging as needed. The WM-PEIS (DOE 1997) assessed long-term storage as its No Action alternative.

Because existing storage space would be rapidly exhausted, new facilities would have to be constructed on-site to store newly generated wastes and some legacy wastes that cannot remain in outside storage. The siting of a new waste storage facility has not been determined. Construction and operation of a potential new storage facility at a location in the northwest portion of the Paducah Site was analyzed in an environmental assessment and found to have no significant impact (DOE 1994).

2.2.2 On-Site treatment

On-site treatment would be performed on wastes that require some type of stabilization prior to storage. Any on-site waste treatment requiring indoor processing would occur in Bldg. C-752-A or another suitable location. The on-site treatment technologies are limited by the RCRA Part B permit. Only a subset of permitted technologies are anticipate to be implemented and are discussed in detail in Sect. 2.1.

2.2.3 Off-site treatment

Under the No Action alternative, no waste would be shipped off-site for treatment.

2.2.4 Waste Transport

Relatively small volumes of waste would continue to be shipped to DOE or commercial disposal facilities under existing and previously approved categorical exclusions (CXs). As these CXs expire, no new ones would be placed, and the waste would then be stored on-site.

2.2.5 Waste Disposal

No waste disposal would occur under the No Action alternative.

2.2.6 Waste Disposition Supporting Activities

Supporting activities for waste under the No Action alternative are the same as for the proposed action, as discussed in Sect. 2.1.6.

2.2.7 DMSA Characterization

No DMSA characterization would occur under the No Action alternative. The DMSA materials would remain stored as they are currently.

2.3 ENHANCED STORAGE ALTERNATIVE

In the Enhanced Storage Alternative (i.e., fortified, long-term storage), DOE would not perform disposition activities except for those needed for waste management and maintenance. This alternative is identical to the No Action alternative except the storage facilities would be constructed for resistance to disasters (such as earthquakes, fires and breech accidents). No disposal of the existing and projected quantities of various wastes outlined in Table 1.1, and discussed under the proposed action, would occur. It should be noted that the enhanced storage alternative would not be compliant with regulatory agreements or the statutory and regulatory provisions described in Sect. 1.1. Ongoing non-CERCLA waste management operations would continue.

2.3.1 Storage

The wastes discussed would be placed in an enhanced on-site storage facility and would require regular maintenance and surveillance by the Paducah Site staff. Also included under this alternative are facility upgrades and waste repackaging as needed.

Because existing storage space does not meet enhanced storage definitions, new facilities would have to be constructed on-site to store wastes. The location of a new enhanced storage facility has not been determined. Construction and operation of a potential new storage facility at a location in the northwest portion of the Paducah Site was analyzed in an environmental assessment and found to have no significant impact (DOE 1994).

2.3.2 On-Site treatment

On-site treatment would be performed on wastes that require stabilization prior to storage. Any on-site waste treatment requiring indoor processing would occur in Bldg. C-752-A or another suitable location. The on-site treatment technologies are limited by the RCRA Part B permit. Only a subset of permitted technologies is anticipated to be implemented and is discussed in detail in Sect. 2.1.

2.3.3 Off-site treatment

Under the Enhanced Storage alternative, no waste would be shipped off-site for treatment.

2.3.4 Waste Transport

Relatively small volumes of waste would continue to be shipped to DOE or commercial disposal facilities under existing and previously approved CXs. As these CXs expire, no new ones would be placed, and the waste would then be stored on-site.

2.3.5 Waste Disposal

No waste disposal would occur under the Enhanced Storage alternative.

2.3.6 Waste Disposition Supporting Activities

Supporting activities for waste under the Enhanced Storage alternative are the same as for the proposed action, as discussed in Sect. 2.1.6.

2.3.7 DMSA Characterization

DMSA characterization would occur as planned for the proposed alternative under the Enhanced Storage alternative.

2.4 ALTERNATIVES CONSIDERED BUT DISMISSED

2.4.1 On-Site Treatment of All Wastes

On-site treatment of all wastes has been dismissed because some technologies needed for waste treatment do not currently exist at the site. Building new facilities to treat all waste types would not be cost effective, would be contrary to decision documents already placed by DOE (see Tables 1.2 and 1.3), and, finally, would not be compliant with the regulatory agreements discussed in Sect. 1.1. On-site treatment of a small amount of waste is proposed under the proposed action and would be accomplished in accordance with the site's RCRA permit and regulatory agreements.

2.4.2 Off-Site Treatment of All Wastes

Off-site treatment of all wastes has been dismissed because some treatment activities are necessary to meet U.S. Department of Transportation (DOT) transportation requirements. Shipping certain waste without treatment would result in violation of DOT regulations. This alternative would also be contradictory to decision documents already placed by DOE (Table 1.2).

2.4.3 On-Site Disposal of All Wastes

DOE considered the option to dispose all wastes on-site. This action would result in the need for new landfill cells built for this purpose. This alternative was not considered reasonable. DOE has already analyzed waste from across the DOE complex and has decided where various waste types should be disposed (see Tables 1.2 and 1.3). In addition, some wastes would have to be shipped offsite for treatement then back to the Paducah site for disposal. Risks associated with shipment of wastes offsite for treatment back to the site for disposal, combined with the impacts from constructing new landfill cells, argue against such an alternative. Finally, this alternative is opposed by local residents; therefore, it was not evaluated further.

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3. AFFECTED ENVIRONMENT

This chapter describes the existing environment in and around the site of the proposed project at the Paducah Site. Information presented pertaining to the proposed transportation routes includes the total mileage (with a breakdown of rural, suburban, and urban miles) and the population density along the highway and rail transportation routes. Methods for determining impacts to the existing area are presented in Appendix C.

The Paducah Site is located within the Jackson Purchase region of western Kentucky in McCracken County, approximately 5.6 km (3.5 miles) south of the Ohio River and 32 km (20 miles) east of the confluence of the Ohio and Mississippi rivers. Even though disposal of USEC program wastes are not evaluated in this document, the following descriptions include all of the Paducah Site, including the portion of the plant that is leased to USEC.

3.1 LAND USE

The Paducah Site is located on a 3423-acre site owned by DOE. Most plant facilities (with the exception of landfills) lie within a fenced security area consisting of 749 acres. Surrounding the security area, DOE maintains a buffer zone of approximately 595 acres, which is used for support services, including the wastewater treatment plant (WWTP) and lagoons for plant water influx and efflux. The buffer zone also contains a construction/demolition debris landfill. The remaining 2079 acres are licensed to the Commonwealth of Kentucky for the purpose of wildlife management in the West Kentucky Wildlife Management Area (WKWMA). The Kentucky Department of Fish and Wildlife Resources (KDFWR) manages this area for the purpose of establishing or maintaining viable wildlife habitat. The property within the buffer zone is not licensed to the Commonwealth of Kentucky, although some is managed by KDFWR with the permission of DOE. DOE maintains the right to assume possession of any property within the buffer zone immediately, if deemed necessary.

The closest municipality to the Paducah Site is the city of Paducah, located approximately 16 km (10 miles) to the east. Several small communities are situated within an 8-km (5-mile) radius of the DOE property boundaries; these include Heath and Grahamville to the east and Kevil to the southwest. Metropolis, Illinois, is located north of the Paducah Site across the Ohio River. Bordering the DOE property to the northeast is the Shawnee Steam Plant, which is owned and operated by Tennessee Valley Authority (TVA). The area surrounding the Paducah Site is predominantly rural, with residences and farms scattered throughout the region.

3.2 GEOLOGY AND SEISMICITY

3.2.1 Geology

The near-surface geology at the Paducah Site, to a depth of approximately 30 m (100 ft), consists of clastic (made up of fragments) continental and marine deposits. The clastic continental deposits are represented by two sedimentary sequences from two distinct depositional periods. The younger clastic sequence, known as the Upper Continental Deposits (UCD), is a silt and clay lacustrine deposit with isolated sand and gravel lenses; it frequently contains perched water zones that comprise the Upper Continental Recharge System (UCRS).

The older clastic sequence, known as the Lower Continental Deposits (LCD), contains a 6- to 21-m (20- to 70-ft)-thick sand and gravel facies that forms the Regional Gravel Aquifer (RGA), which is the primary source of drinking water north of the Paducah Site. No residences in the immediate vicinity of the Paducah Site rely upon the RGA for groundwater supply, as most have been supplied with municipal water. No economic geological resources (e.g., mineral deposits) have been identified at the Paducah Site.

3.2.2 Seismicity

The Paducah Site is located in an area with a seismic risk rating of 3, the most severe rating on a scale of 1 to 3. Several minor seismic tremors have been recorded at the Paducah Site since the early 1950s; the largest, in 1962, measured 5.5 on the Richter scale. There has, however, never been a release of contaminants or structural failure at the Paducah Site as the result of seismic activity.

3.3 SOILS AND PRIME FARMLAND

3.3.1 Soils

The soils in the vicinity of the Paducah Site consist of silty loam and silty clay loam lying above the loess and alluvium surficial deposits. Six soil series are mapped in proximity to the Paducah Site (USDA 1976). These soil series include the Calloway silt loam, Grenada silt loam, Loring silt loam, Falaya-Collins silt loam, Vicksburg silt loam, and Henry silt loam. The Calloway-Henry association is the predominant soil association found in the vicinity of the Paducah Site. All but the Henry series can be considered prime farmland based on general soil properties.

Henry soils are nearly level, poorly drained soils with a fragipan (having a higher bulk density than the soil above, seemingly cemented when dry, but showing moderate to weak brittleness when moist) that formed in thick deposits of loess or alluvium. Henry soils have moderate permeability [from 1.6 to 5.08 cm/h (0.63 to 2.0 in./h)] above the fragipan, which forms between 43 and 66 cm (17 and 26 in.) from the surface, and slow permeability [<0.5 cm/h (<0.2 in./h)] within and below the fragipan. The water table is perched above the fragipan and extends to the surface during wet seasons (USDA 1976).

Calloway silt loam is somewhat poorly drained with a fragipan that formed in loess. These soils have moderate permeability [from 1.6 to 5.08 cm/h (0.63 to 2.0 in./h)] above the fragipan, which is between 66 and 127 cm (26 and 50 in.) below the surface, and slow permeability [<0.5 cm/h (<0.2 in./h)] within and below the fragipan. These soils have perched water tables that are from 15 to 46 cm (6 to 18 in.) below the surface during wet seasons. Slopes range from 0 to 6%.

Soils in the Grenada series are moderately well drained and were formed in loess on relatively smooth uplands and in alluvium washed mostly from loess on stream terraces. The depth to the fragipan ranges from 30 to 61 cm (12 to 24 in.), with an average depth of 36 cm (14 in.). The soil above the fragipan is moderately permeable [from 1.6 to 5.08 cm/h (0.63 to 2.0 in./h)], while the fragipan is relatively impermeable [<0.5 cm/h (<0.2 in./h)]. Soils below the fragipan have moderately slow permeability [from 0.5 to 1.6 cm/h (0.2 to 0.63 in./h)]. The water table is perched above the fragipan during wet periods.

The Vicksburg series consists of well-drained, nearly level soils on floodplains of branches and creeks. These soils formed in sediments washed mainly from loess. These soils have moderate permeability [from 1.6 to 5.08 cm/h (0.63 to 2.0 in./h)]. The water table is generally from 0.6 to 0.9 m (2 to 3 ft) below ground surface. Some soils are subject to flooding, but the floods are generally for short duration, and the erosion hazard is slight (USDA 1976).

3.3.2 Prime Farmland

Prime farmland, as defined by the U.S. Department of Agriculture Natural Resources Conservation Service, is land that is best suited for food, feed, forage, fiber, and oilseed production. It does not include "urban built-up land or water" (7 *CFR* 657 and 658). The Natural Resources Conservation Service determines prime farmland primarily on the basis of soil types found to exhibit desirable soil properties. These soil properties include soil quality, growing season, moisture supply, and other properties needed to produce sustained high yields of crops in an economical manner.

The following soil series, located in the vicinity of the Paducah Site, are considered to be representative of prime farmland: Calloway silt loam, Falaya-Collins silt loam, Grenada silt loam, Loring silt loam, and Vicksburg silt loam. These soil types are not likely to be found at the site. The soils at the site have been disturbed as a result of construction and maintenance activities at the Paducah Site since the early 1950s.

3.4 WATER RESOURCES AND WATER QUALITY

3.4.1 Water Resources

The Paducah Site is located in the western part of the Ohio River Basin. The confluence of the Ohio and Tennessee rivers is approximately 16 km (10 miles) upstream of the site. The confluence of the Ohio River with the Mississippi River is approximately 32 km (20 miles) downstream of the site.

The Paducah Site is located on a local drainage divide; surface flow is to the east and northeast toward Little Bayou Creek and to the west and northwest toward Bayou Creek. The confluence of the creeks is approximately 5 km (3 miles) north of the site. Little Bayou Creek originates in the WKWMA and flows north toward the Ohio River along a 10.5-km (6.5-mile) course through the eastern portion of the DOE reservation.

The 11,910-acre drainage basin of Bayou Creek is about twice that of Little Bayou Creek (approximately 6000 acres). During dry periods, natural runoff makes up the flow in Bayou and Little Bayou creeks.

Bayou Creek is a perennial stream; its drainage basin extends from approximately 4 km (2.5 miles) south of the Paducah Site to the Ohio River. Bayou Creek flows north toward the Ohio River along a 14-km (9-mile) course that passes along the western boundary of the site..

3.4.2 Water Quality

Kentucky Department of Environmental Protection (KDEP) has not formally classified Little Bayou Creek. According to state regulations [401 *Kentucky Administrative Regulations* (*KAR*) 5:026], however, any waters not specifically classified by KDEP are otherwise designated for the following uses: warm water aquatic habitat, primary contact recreation, secondary contact recreation, and domestic water supply; therefore Little Bayou Creek is classified for these uses by default. Little Bayou Creek receives point and nonpoint source effluent discharges from the Paducah Site, including process effluent, treated sewage, and storm water discharge under KPDES permit KY00040. The Paducah Site's effluent discharges account for nearly all of the flow in Little Bayou Creek.

Bayou Creek receives effluent discharge from the Paducah Site, including process effluent, treated sewage, and storm water discharge under KPDES permit KY0004049 (October 22, 1986) and an Agreed Order with the Commonwealth of Kentucky (October 12, 1987). The most current KPDES permit became effective on April 1, 1998, and has an expiration date of March 31, 2003.

3.4.3 Groundwater

The uppermost aquifer in the Paducah Site area, the RGA, is developed in the lower gravel facies of the LCD. Recharge occurs as leakage from the UCD, including the UCRS. In general, flow in the RGA is to the north, to discharge into the Ohio River or alluvial deposits along the river. The predominantly fine-grained deposits of the McNairy Formation act as a basal confining layer for the RGA. Groundwater movement within the McNairy aquifer is north toward the Ohio River (DOE 2000c).

The UCRS is composed of heterogeneous silt and clay layers with interbedded or interlensed layers of sand and gravel. The distribution and depth of the sand and gravel layers determine the location of the water table within this recharge system. The discontinuous sandy horizons interbedded with finer-grained units result in perched groundwater throughout the UCRS.

Groundwater flow through the loess and clay-silt facies of the UCD is predominantly downward in the Paducah Site area. Seasonally saturated perched zones occur in the surficial soils above fragipans and in isolated sand lenses of the UCD. These sand lenses can produce only limited quantities of water during wet seasons. The limited extent of sands in the UCD offers little enhancement of pathways for pollution migration. Use of perched aquifers for water supply is unknown in the Paducah Site area but cannot be ruled out. Groundwater flow through the UCD is predominantly vertically downward rather than horizontally outward, and the sands are generally saturated only seasonally.

3.4.4 Floodplains

Flooding in the vicinity of the storage site and the proposed on-site treatment area would be caused by headwater flooding from Little Bayou Creek and would not be affected by backwater flooding from the Ohio River for a 500-year or lesser flood. The 100-year flood elevation for Little Bayou Creek ranges from about 108 to 110 m (355 to 360 ft) above mean sea level (MSL) about 1.6 km (1 mile) east of the site. The elevation of the nearest tributary to Little Bayou Creek is approximately 105 m (345 ft) above MSL. Ground surface elevations are approximately 111 m (365 ft) above MSL, which is well above the 100-year and 500-year flood elevations.

Headwater flooding from Bayou Creek could cause flooding in the vicinity of the storage site and would not be affected by backwater flooding from the Ohio River for a 500-year or lesser flood. The 100-year flood elevation for Bayou Creek ranges from about 111 to 111.5 m (365 to 366 ft) above MSL. The 500-year flood elevation ranges from about 111.5 to 112 m (366 to 367 ft) above MSL.

3.4.5 Wetlands

According to the U.S. Army Corps of Engineers (COE) Wetlands Investigation Report (COE 1994, Vol. IV), there are no wetlands within the boundaries of the storage site and the on-site treatment area. However, a small wetland of about 1 acre is mapped near the northwest corner of the site. As previously stated in the COE report, none of the potentially affected wetlands is of high ecological value in a regional context.

3.5 ECOLOGICAL RESOURCES

3.5.1 Vegetation

The DOE reservation at Paducah is a highly disturbed area. Vegetation communities are indicative of old-field succession (i.e., grassy fields, field scrub-shrub, and upland mixed hardwoods).

Open grassland areas managed by WKWMA are periodically mowed or burned to maintain early successional vegetation, which is dominated by members of the composite family and various grasses. Management practices of the WKWMA encourage re-establishment of once-common native grasses such as eastern gama grass (*Tripsacum dactyloids*) and Indian grass (*Sogastrum sp.*). Commonly cultivated for wildlife forage are corn, millet, milo, and soybean (CH2M HILL 1992). Field scrub-shrub communities consist of sun-tolerant woody species such as persimmon (*Diospyros virginiana*), maples (*Acer spp.*), black locust (*Robinia pseudoacacia*), sumac (*Rhus spp.*), scattered oaks (*Quercus spp.*), and mixed hardwood species (CH2M HILL 1992). The understory may vary depending on the location of the woodlands. Wooded areas near maintained grasslands may have an understory dominated by grasses. Other communities may contain a thick understory of shrubs, including sumac, pokeweed (*Phytolacca americana*), honeysuckle (*Lonicera japonica*), blackberry (*Rubus sp.*), and grape (*Vitis sp.*).

Upland mixed hardwoods contain a variety of upland and transitional species. Dominant species include oaks, shagbark and shellbark hickory (*Carya ovata, C. laciniosa*), and sugarberry (*Celtis laevigata*) (CH2M HILL 1992). The understory may vary from very open, with limited vegetation for more mature stands of trees, to dense undergrowth similar to those described for a scrub-shrub community.

3.5.2 Wildlife

This section describes the terrestrial (Sect. 3.5.2.1) and aquatic (Sect. 3.5.2.2) animals that have been observed at the Paducah Site and surrounding area.

3.5.2.1 Terrestrial Wildlife

Wildlife commonly found at the Paducah Site consists of species indigenous to open grassland, thickets, and forest habitats. Observations by ecologists during investigations at the site and information from WKWMA staff provided a qualitative description of wildlife likely to inhabit the vicinity of the site. The primary game species hunted for food in the area are deer (*Odocoileus virginianus*), turkey *(Meleagris gallopavo)*, opossum *(Didelphis marsupialia)*, rabbit *(Sylvilagus floridanus)*, raccoon *(Procyon lotor)*, and squirrel *(Sciurus* spp. and *Tamiasciurus hudsonicus)*. Both game and nongame species are attracted to the area because of the intense habitat management program that has been implemented in the WKWMA (CH2M HILL 1991). Herpetofauna (amphibian and reptile), bird, and mammal species occurring at the Paducah Site are listed in tables in Appendix D of this report.

Small mammal surveys conducted on the WKWMA [Kentucky State Nature Preserves Commission (KSNPC) 1991] documented the presence of southern short-tailed shrew *(Blarina carolinensis)*, prairie vole *(Microtus ochrogaster)*, house mouse *(Mus musculus)*, rice rat *(Oryzomys palustris)*, and deer mouse *(Peromyscus sp.)*. Larger mammals commonly present in the area include coyote *(Canis latrans)*, eastern cottontail *(Sylvilagus floridanus)*, opossum *(Didelphis marsupialis)*, groundhog *(Marmota monax)*, white-tailed deer *(Odocoileus virginianus)*, raccoon *(Procyon lotor)*, striped skunk *(Mephitis mephitis)*, and gray squirrel *(Sciurus carolinensis)*. Mist-netting activities in the Paducah Site area have captured red bat *(Lasiurus borealis)*, little brown bat *(Myotis lucifugus)*, Indiana bat *(Myotis sodalis)*, northern long-eared bat *(Myotis septentrionalis)*, evening bat *(Nycticeus humeralis)*, and eastern pipistrelle *(Pipistrellus subfavus)*.

Late spring roadside surveys conducted by Battelle (1978) reported 45 species of birds in the Paducah Site area, with northern bobwhite *(Colinus virginianus)*, northern cardinal *(Cardinalis cardinalis)*, indigo bunting *(Passerina cyanea)*, common grackle *(Quiscalus quiscula)*, eastern towhee (*Pipilo erythrophthalmus)*, and European starling *(Sturnus vulgaris)* being the most abundant. Other common species include mourning dove *(Zenaida macroura)*, barn swallow *(Hirundo rustica)*, blue jay *(Cyanocitta cristata)*, common crow *(Corvus brachyrhynchos)*, northern mockingbird *(Mimus polyglottos)*, brown thrasher *(Toxostoma rufum)*, common yellowthroat *(Geothlypis trichas)*, eastern meadowlark *(Sturnella magna),* and red-winged blackbird *(Agelaius phoeniceus).* The red-tailed hawk *(Buteo jamaicensis)* and American kestrel *(Falco sparverius)* were the most common raptors.

Several reptile and amphibian species are present in the vicinity of the Paducah Site. Herpetofauna documented by the KSNPC include cricket frogs *(Acris crepitans),* Fowler's toad *(Bufo woodhousii fowleri),* common snapping turtle *(Chelydra serpentina),* green treefrog *(Hyla cineria),* chorus frog *(Psuedacris triseriata),* southern leopard frog *(Rana ultricularia),* eastern fence lizard *(Sceloporus undulatus),* and red-eared slider *(Trachemys scripta elegans)* (KSNPC 1991).

3.5.2.2 Aquatic Wildlife

Streams. Semiannual surveys conducted by the ORNL Environmental Sciences Division (ESD) from 1992 through 1998 documented fish diversity in Bayou and Little Bayou creeks (Roy et al. 1996; Ryon and Carrico 1998; Kszos et al. 1997). A list of species occurring in both creeks during the ESD survey period is shown in Table I.4 of Appendix D. Over all surveys, Bayou and Little Bayou creeks yielded 51 and 39 species, respectively. Based on density, central stoneroller *(Campostoma anomalum)* and longear sunfish *(Lepomis megalotis)* are the predominant fish inhabiting these streams. Four minnow species found in both creeks [common carp *(Cyprinus carpio),* red shiner *(Notropis lutrensis),* golden shiner *(Notemigonus crysoleucas),* and fathead minnow *(Pimephales promelas)*] and grass carp *(Ctenopharyngodon idellus),* collected in Bayou Creek, are not native to western Kentucky.

Slight differences in species composition between Bayou and Little Bayou creeks are probably attributable to differences in stream size and watershed area. More taxa were collected from Bayou Creek, which has an 11,910-acre catchment that is almost twice as large as the 6000-acre Little Bayou Creek catchment. Species that prefer large bodies of water—bowfin *(Amia calva),* river carpsucker (*Carpiodes carpio*), smallmouth buffalo *(Ictiobus bubalus),* bigmouth buffalo *(Ictiobus cyprinellus),* and black buffalo *(Ictiobus niger)*—were present in Bayou Creek but absent in Little Bayou Creek. Habitat conditions in Little Bayou Creek tend to favor mosquitofish *(Gambusia affinis),* blackspotted topminnow *(Fundulus olivaceous),* and green sunfish *(Lepomis cyanellus)* populations. Headwaters are more variable in flow regime and temporal habitat quality than are downstream areas; therefore, they favor species that are adapted either to consume a broader breadth of resources or to feed in a broader number of habitats. Mosquitofish and blackspotted topminnow, which both feed almost exclusively on insects at or near the surface, and green sunfish, a generalist omnivore, constitute a larger portion of communities in the upper reaches of Little Bayou Creek than at other sites in area streams.

Lakes and Ponds. Lentic habitats, including 13 ponds used for fishing, are located primarily in the WKWMA. No ponds are present within the Paducah Site security fence. Largemouth bass *(Micropterus salmoides),* bluegill *(Lepomis macrochirus),* and, to a lesser extent, green sunfish are the predominant species inhabiting ponds. Recently, contaminants were found in ponds located in the Kentucky Ordnance Works area, resulting in posting of warning signs. Little Bayou Creek also was previously fished; however, detection of elevated concentrations of PCBs in fish taken from Little Bayou Creek resulted in posting of consumption warnings. Amphibians, muskrat *(Ondatra zibethicus),* beaver *(Castor canadensis),* and many species of water birds, including wood duck (Aix *sponsa),* Canada goose *(Branta canadensis),* great blue heron *(Ardea herodias),* and green heron *(Butorides striatus),* use pond habitats and associated riparian areas. In addition to fishing ponds, there are many smaller ponds and abandoned gravel pits in the area that usually contain water and may support aquatic life.

3.5.3 Threatened and Endangered Species

Mussels including the orange-footed pimpleback (*Plethobasus cooperianus*), pink mucket pearly mussel (*Lampsilis arbrupta),* ring pink (*Obovaria retusa*), fat pocketbook (*Potamilis capax*), as well as the Indiana bat (*Myotis sodalis*) are federally listed endangered species that may be found in or near McCracken County (COE1994).

The KDFWR conducted a mist net survey during the summer of 1999 on the WKWMA, which surrounds the Paducah Site. Five Indiana bats were captured during the survey (KDFWR 2000). The four mussel species have not been identified in water resources near the Paducah Site however they have been recorded between river miles 945 and 949 of the Ohio River, downstream from Metropolis, Illinois, and downstream of the confluence of Bayou Creek and the Ohio River (KSNPC 2000).

Indiana bats winter in caves, but during their reproductive season (usually from May 15 to August 15), the bats would form colonies in mature trees with loose bark, such as shagbark hickory, especially near water (CH2M HILL 1992). The range of the endangered Indiana bat is the eastern United States from Oklahoma, Iowa, and Wisconsin east to Vermont and south to northwestern Florida. Distribution is associated with major cave regions and areas north of cave regions. The present total population is estimated at ca. 352,000 with more than 85 percent hibernating at only nine locations - two caves and a mine in Missouri, three caves in Indiana, and three caves in Kentucky.

The orange-footed pearly mussel, a clam, is a federally listed endangered species that inhabits sand and gravel shoals and riffles. Current range of this species includes the Ohio River in reaches adjacent to Ohio, Indiana, Illinois, and Kentucky. It is a species associated with large rivers.

The federally endangered pink mucket pearly mussel (41 FR 24062; June 14, 1976) is a bivalve aquatic mollusk in the Unionidae family with an elliptical-shaped shell. The pink mucket is found in medium to large rivers. It seems to prefer larger rivers with moderate- to fast-flowing water, at depths from 0.5 to 8.0 m (1.6 to 26.2 ft). The species has been found in substrates including gravel, cobble, sand, or boulders. Currently, the pink mucket is known in 16 rivers and tributaries from 7 states, with the greatest concentrations in the Tennessee (Tennessee, Alabama) and Cumberland (Tennessee, Kentucky) rivers and in the Osage and Meramec rivers in Missouri. Smaller populations have been found in the Clinch River (Tennessee); Green River (Kentucky); Ohio River (Illinois); Kwanawha River (West Virginia); Big Black, Little Black, and Gasconde rivers (Missouri); and Current and Spring rivers (Arkansas).

The ring pink mussel was listed as an endangered species without critical habitat on September 29, 1989 (54 FR 40109). The U.S. Fish and Wildlife Service (FWS) (FWS 1991) formerly referred to this mussel as the golf stick pearly mussel. The ring pink mussel is one of the most endangered mussels because all of the known populations are apparently too old to reproduce. This mussel is characterized as a large-river species (FWS 1991). Historically, this mussel was widely distributed and found in several major tributaries of the Ohio River, including those that stretched into Alabama, Kentucky, Illinois, Indiana, Ohio, Pennsylvania, and West Virginia. However, the species was last taken in Pennsylvania in 1908, and in Ohio in 1938 (FWS 1991). According to records, this species has not been collected in Indiana in decades, and has not been collected from Illinois in over 30 years (FWS 1991).

The fat pocketbook mussel was listed as a federally endangered species in 1976 (41 FR 24064). The fat pocketbook mussel inhabits rivers and streams with sand, mud, or gravel substrates. It prefers slow-flowing water where depths range from a few inches to 8 ft. There are few published records on the historical distribution of this species for the period prior to 1970. Museum records indicated that most fat pocketbook occurrences were from three areas; the upper Mississippi River (above St. Louis, Missouri), the Wabash River in Indiana, and the St. Francis River in Arkansas. There are a few historic records of this species occurring in the Illinois River, but is has not been found in recent years (FWS 1989). Currently, the fat pocketbook in the mid-west is found only in the lower Wabash River in Indiana, the Ohio River adjacent to Kentucky, Indiana, and Illinois, and in the lower Cumberland River in Kentucky (FWS 1989).

The potential occurrence of federally and state-listed threatened and endangered species at the Paducah Site was determined by contacting the USFWS, KDFWR, and the KSNPC. Consultation letters describing the proposed action were submitted to the agencies requesting comments regarding potential effects of the proposed action. Copies of these letters and responses from the agencies are in Appendix E.

The consultation response from the FWS dated August 16, 2001, requested that a Biological Assessment be prepared for the Indiana bat and 4 mussel species. Preparation of the Biological Assesment determined that the project, as proposed, would be unlikely to adversely affect the Indiana bat or any mussel species of concern because:

- while a potential for exposure of the bat and mussel species to waste as a result of an accident during implementation of the proposed action would be small and there is nothing conclusive to indicate that such exposure would be detrimental to the species;

- proposed waste disposition activities are currently being performed at the Paducah Site with no known detriment to the local Indiana bat or mussel populations. The numbers of Indiana bats caught from mist netting in the area has risen from 1 in 1991 to 5 in 2000 and mussel species have been sampled on the opposite side of the Ohio River as recently as 2000; (KSMC 2000)

- no bat foraging or roosting habitat is present inside the site fence where waste disposition activities would occur. Potential habitats identified outside the site fence would not be affected by routine waste disposition activities;

- the majority of mussel habitat in the area has been identified up stream from the Paducah Site would not be affected by routine waste disposition operations; no mussel habitat exists inside the site fence and where waste disposition activities are proposed;

- bat foraging habitat (riparian vegetation along intermittent tributaries) present near the site of the proposed action is unlikely to become contaminated;

- routine waste management operating procedures would leave minimal opportunity for direct exposure of local biota and their prey, to wastes. This practice would also decrease the probability of accidents; and

- no bat or mussel habitat alteration or destruction would occur as a result of the proposed action.

A copy of the Final Biological Assessment in its entirety is included in Appendix F of this document.

There is no official listing of threatened or endangered species for the Commonwealth of Kentucky. A list of plant and animal species identified is maintained for monitoring purposes, by KSNPC (Table 3.1). There are currently no compliance requirements for these "state-listed" species.

Of the state-listed birds for the area [i.e., the endangered hooded merganser (*Lophodytes cucullatus*), the fish crow (*Corvus ossifragus*), and Bell's vireo (*Vireo Bellii*)—all of which are species of special concern, only Bell's vireo has been observed recently on the DOE reservation (CH2M HILL 1992). Commonwealth-listed mammals potentially occurring in the area include the evening bat (*Nycticeius humeralis*) and the northern long-eared bat (*Myotis septentrionalis*). None of the mammals has been observed on the DOE reservation. The KDFWR database lists the northern crawfish frog (*Rana areolata circulosa*), a species of special concern, as occurring within the Heath quadrangle, which contains the Paducah Site (KSNPC 1991). Additional animal species noted by other investigators as occurring within the area, but not listed by KDFWR or KSNPC as occurring in McCracken County, include the lake chubsucker

(*Erimyzon sucetta*), a state-threatened species, and the great blue heron (*Ardea herodias*), a species of special concern. The lake chubsucker has been found in Bayou Creek (CH2M HILL 1991), and the great blue heron has been observed during site reconnaissance near KPDES Outfall 001 (CDM 1994) and in other plant industrial ponds. Commonwealth-listed animal species known from McCracken County are presented in Table 3.1; however, not all of these species are known from the vicinity of the Paducah Site.

Commonwealth-listed endangered and threatened plants that may occur in the area include the endangered Carolina silverbell (*Halesia carolina*) and the threatened compass plant (*Silphium laciniatum*). The Carolina silverbell occurs in moist or hydric areas often associated with floodplains or other low-lying areas in which water collects (KSNPC 1991). The compass plant occurs within open fields and sometimes along roadsides (KSNPC 1991). Commonwealth-listed plant species known from McCracken County are listed in Table 3.2; however, not all of these species are known from the vicinity of the Paducah Site. Commonwealth of Kentucky-listed species are not afforded any special protection but should be monitored, if possible, for location and abundance.

No commonwealth or federally listed plant species are known or are likely to occur within the Paducah Site security fence. Habitat at the proposed work site has been previously disturbed, is mowed on a regular basis, and is unlikely to support any of the aforementioned listed species. Because of the availability of suitable habitat at the Paducah Site, the following three Commonwealth of Kentucky-listed species might occur: (1) Bell's vireo (but this species has not been sighted near the Paducah Site recently), (2) the great blue heron (which has been observed), and (3) the Carolina silverbell, due to the moist woodlands on the site. Thorough evaluations, however, have not identified the Carolina silverbell at the site. Shagbark hickories and elms, known to occur in the wooded areas, may provide suitable habitat for the federally listed Indiana bat. Given the close proximity to industrial operations, it is unlikely that Indiana bats would select an area at the Paducah Site for colonization, especially when more suitable areas (i.e., more secluded and mature woodlands) are readily available in the vicinity.

Habitat for the Bachman's sparrow (*Aimophila aestivalis*), a federal candidate species, includes pasture, old-field habitat, short shrub or fencerow ecotones, or previously disturbed grassland areas. Such habitat does exist in the vicinity. No formal information exists related to sightings of this species in the vicinity of the proposed work areas; however, this species is not afforded any special protection, and Sect. 7 requirements of the Endangered Species Act do not apply.

3.5.4 Parks and Scenic Rivers

There are no state or national parks, forests, conservation areas, or scenic and wild rivers in the vicinity of the Paducah Site.

3.6 NOISE

Ambient noise levels are not measured at the Paducah Site or at any nearby facilities. There are currently no local ordinances concerning noise regulation. The Commonwealth of Kentucky has a law concerning noise regulation; however, no enforcement or monitoring program exists, and no regulations governing the implementation of this law have been promulgated.

Noise from industrial processes taking place at the plant is generally restricted to the interior of the plant buildings. Noise levels beyond the plant security fence are generally the result of vehicular traffic moving through the area.

Table 3.1. Commonwealth of Kentucky threatened, endangered, and "special concern" animal species known from McCracken County, Kentucky

Threatened species	Endangered species	"Special concern" species
Erimyzon sucetta (lake chubsucker)	*Acipenser fulvescens* (lake sturgeon)	*Ardea herodias* (great blue heron)
Hyla avivoca (bird voiced tree frog)	*Hialaeetus leucocephalus** (bald eagle)	*Corvus ossifragus* (fish crow)
Lepomis punctatus (spotted sunfish)	*Hybognathus hayi* (cypress minnow)	*Esox niger* (chain pickerel)
Lepomis minatus (redspotted sunfish)	*Lampsilis abrupta** [pink mucket (mussel)]	*Hyla cinerea* (green tree frog)
Macroclemys temminckii (alligator snapping turtle)	*Lepisosteus spatula* (alligator gar)	*Ichthyomyzon castaneus* (chestnut lamprey)
Notropis maculatus (taillight shiner)	*Lophodytes cucullatus* (hooded merganser)	*Ictiobis niger* [black buffalo (fish)]
Nycticeius humeralis (evening bat)	*Myotis sodalis* (Indiana bat)	*Lota lota Burbot* (fresh water cod)
	Orconectes lancifer (crayfish)	*Myotis septentrionalis* (northern long-ear bat)
	Obovaria retusa [rink pink (mussel)]	*Nerodia erythrogaster* (copperbelly water snake)
	*Plethobasus cooperianus** [orange foot pimpleback (mussel)]	*Notropis venustus* (blacktail shiner)
		Noturus stigmosus [northern madtom (fish)]
	Myotis austroriparius (Southeastern bat)	*Rana areolata* (northern crawfish frog)
	Potamilus capax [fat pocketbook (mussel)]	*Riparia riparia* (bank swallow)
		Vireo bellii [bell's vireo (bird)]

Table 3.2. Commonwealth of Kentucky threatened, endangered, and "special concern" plant species known from McCracken County, Kentucky

Threatened species	Endangered species	"Special concern" species
Halesia carolina (carolina silverbell)	*Hypericum adpressum* (creeping St. John's-wort)	*Baptisia leucophaea* (cream wild indigo)
Rudbeckia subtomentosa (sweet coneflower)	*Prenanthes aspera* (rough rattlesnake-root)	*Carex triangularis* (fox sedge)
Silphium laciniatum (compass plant)		*Carya aquatica* (water hickory)
		Heterotheca latifolia (broad-leaf golden aster)
		Lathyrus palustris (vetchling peavine)
		Malus angustifolia (Southern crab apple)
		Muhlenbergia glabriflora (hair grass)
		Solidago buckleyi (buckley's goldenrod)

3.7 CULTURAL, ARCHAEOLOGICAL, AND NATIVE AMERICAN RESOURCES

Inside a study area of about 12,000 acres in and around the Paducah Site, there are 35 sites of cultural significance recorded with the State Historic Preservation Officer and several more unrecorded sites (COE 1994). Most of these are prehistoric and located in the Ohio River floodplain. Six of the sites are on DOE property at the Paducah Site but are not within the site fence. None of the sites is included in, or has been nominated to, the National Register of Historic Places, even though some are potentially eligible. There are no identified Native American resources in the area.

3.8 CLIMATE AND AIR QUALITY

3.8.1 Climate

The Paducah area is located in the humid continental zone, characterized by warm summers and moderately cold winters. The annual temperature in the Paducah area averages about 14°C (57°F), with the highest monthly average temperature of 26°C (79°F) in July and the lowest of approximately 2°C (35°F) in January (DOE 2000b, 1999). Annual precipitation averages about 124 cm (49 in.) and is primarily in the form of rain. Data for the period 1985–1993 indicate that the average relative humidity is about 86% at 6 a.m. and about 58% at noon (DOE 1999a).

Average wind speed in the area is about 8.1 mph based on the most recent available data collected at the Barkley Regional Airport near Paducah for the period 1985–1992 (EPA 2000). As shown in Fig. 3.1, dominant wind directions are from the south and south-southwest at an average wind speed of about 9.0 mph.

3.8.2 Air Quality and Applicable Regulations

The Paducah area is located in the Paducah-Cairo Interstate Air Quality Control Region. The commonwealth's ambient air quality standards for six criteria of air pollutants—sulfur oxides as sulfur dioxide (SO^2), particulate matter with an aerodynamic diameter less than 10 μm (PM_{10}), carbon monoxide, ozone, nitrogen dioxide, and lead—are identical to the national ambient air quality standards (401 *KAR* 53:010). The primary ambient air quality standards, which are for the protection of public health, and the secondary ambient air quality standards, which are for the protection of welfare and the environment, are listed in Table 3.3. In addition, the Commonwealth of Kentucky has promulgated ambient standards for hydrogen sulfide, gaseous and total fluorides, and odors. These standards also are shown in Table 3.3.

Current air quality is good in the Paducah area. The area is designated as a Class II prevention of significant deterioration (PSD) area. New emission sources are not permitted to "notably" degrade air quality, with significance, defined in terms of maximum ambient air increments established for a Class II area (401 *KAR* 51:017). The nearest Class I PSD areas, where more stringent ambient air quality requirements must be met, are the Mingo National Wildlife Refuge in Missouri, approximately 145 km (90 miles) west of the Paducah Site, and Mammoth Cave National Park in Mammoth Cave, Kentucky, 217 km (135 miles) east of the Paducah Site (DOE 1999a).

3.8.3 Ambient Air Monitoring Near the Paducah Site

The ambient air quality is monitored regularly in the Paducah area and at the Paducah Site. Both the Commonwealth of Kentucky and USEC operate a monitoring network to determine ambient air concentrations of regulated pollutants. Table 3.3 lists the highest background concentrations that can be considered representative of the Paducah area based on 1996 background data.

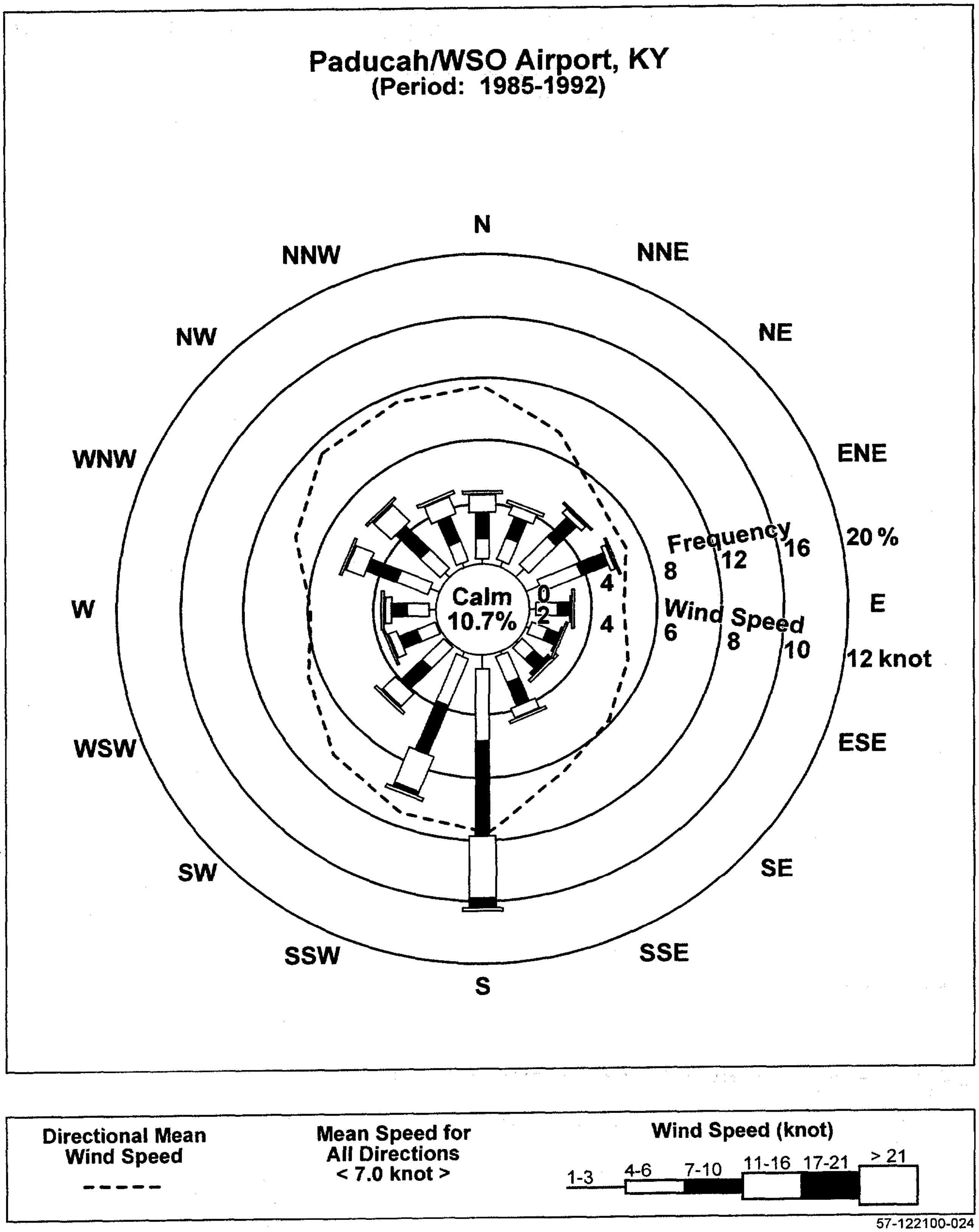


Fig. 3.1. Wind rose patterns of wind speed frequency and directional wind speed at the Barkley Airport.

Table 3.3. Commonwealth of Kentucky ambient air quality standards and highest background levels representative of the Paducah area*

Pollutant	Primary standard	Secondary standard	Highest background level
Sulfur oxides (sulfur dioxide) ($\mu g/m^3$)			
Annual arithmetic mean	80 (0.03 ppm)	–	13
Maximum 24-h average	365 (0.14 ppm)	–	55
Maximum 3-h average	–	1300 (0.50 ppm)	138
Particulate matter, measured as PM_{10} ($\mu g/m^3$)			
Annual arithmetic mean	50	50	24
Maximum 24-h average	150	150	83
Carbon monoxide (mg/m^3)			
Maximum 8-h average	10 (9 ppm)	Same as primary	4.9
Maximum 1-h average	40 (35 ppm)	Same as primary	6.9
Ozone ($\mu g/m^3$)			
Maximum 1-h average	235 (0.12 ppm)	Same as primary	182
Nitrogen dioxide ($\mu g/m^3$)			
Annual arithmetic mean	100 (0.05 ppm)	Same as primary	24
Lead ($\mu g/m^3$)			
Maximum arithmetic mean averaged over a calendar quarter	1.5	Same as primary	0.04
Hydrogen sulfide ($\mu g/m^3$)			
Maximum 1-h average	–	14 (0.01 ppm)	I
Gaseous fluorides, expressed as hydrogen fluoride ($\mu g/m^3$)			
Annual arithmetic mean	400 (0.5 ppm)	–	0.16
Maximum 1-month average	–	0.82 (1.00 ppb)	–
Maximum 1-week average	–	1.64 (2.00 ppb)	0.615
Maximum 24-h average	800 (1.0 ppm)	2.86 (3.50 ppb)	–
Maximum 12-h average	–	3.68 (4.50 ppb)	–
Total fluorides (ppm) Dry-weight basis (as fluoride ion) in and on forage for consumption by grazing ruminants. The following concentrations are not to be exceeded:			
• Average concentration of monthly samples over growing season (not to exceed six consecutive months)	–	40 (w/w)**	–
• 2-month average	–	60 (w/w)**	–
• 1-month average	–	80 (w/w)**	–

* Based on 1996 background data.
** w/w = weight/weight basis

The Paducah area, including the DOE Paducah Site, is currently an attainment area for all criteria pollutants. The largest air pollution sources near the Paducah area include USEC and TVA's coal-fired Shawnee Power Plant, approximately 5 km (3 miles) north-northeast of the Paducah Site. The Joppa Power Plant and the Allied Signal Metropolis Works Uranium Hexafluoride Conversion Plant are located across the Ohio River in Illinois; they are approximately 10 km (6 mi) northwest and 8 km (5 mi) northeast of the Paducah Site, respectively.

3.9 SOCIOECONOMICS AND ENVIRONMENTAL JUSTICE

3.9.1 Socioeconomics

The region of influence (ROI) for the socioeconomic impact analysis includes McCracken County, Kentucky, where the Paducah Site is located. Although surrounding counties also could be included, the assumption that all socioeconomic impacts would occur within the county identifies an upper bound on potential impacts. To the extent that any impacts spread to the surrounding counties, the relative effect on any one county would be smaller than those estimated here.

As of 1997, McCracken County's population totaled 64,773, with total employment of 45,879 and per capita income of $24,231 (BEA 1999). DOE and USEC currently employ about 2200 individuals at the Paducah Site (BJC 2000).

3.9.2 Environmental Justice

For the purposes of this analysis, a minority population consists of any area in which minority representation is greater than the national average of 24.2%. Minorities include individuals classified by the U.S. Bureau of the Census as Negro/Black/African-American, Hispanic, Asian and Pacific Islander, American Indian, Eskimo, and Aleut. Since Hispanics may be of any race, nonwhite Hispanics are included in only the Hispanic category and not under their respective minority racial classifications. The demographics of the Paducah Site, with respect to income level and minority status, were evaluated in detail in the WM-PEIS (DOE 1997). Overall, the population within an 80-km (50-mile) radius of the Paducah Site does not contain a higher minority representation than the national average. While several census tracts to the north and southwest include minority populations above the national average, these locations are not near the Paducah Site (DOE 1999a).

Because any adverse health or environmental impacts are likely to fall most heavily on the individuals nearest the Paducah facility, it is also important to examine the populations in the closest census tracts. As of the 1990 census, none of the tracts closest to the site contained minority populations above the national average. The highest minority representation was 5.2% in tract 314 (McCracken County) (Bureau of the Census 1990a). No federally recognized Native American tribes are in the area.

The WM-PEIS did determine that a higher percentage of the population surrounding the Paducah Site qualified as low income than the national average. In this analysis, a low-income population includes any census tract in which the percentage of persons with incomes below the poverty level is greater than the national average of 13.1% (Bureau of the Census 1990b). Of the tracts closest to the site, 9701, 9703, and 9501 show percentages of low-income populations above the national average; approximately 17% of each of these populations is low income. Tracts 9701 and 9703 are directly across the Ohio River in Massac County, Illinois. Tract 9501 is west of the site in Ballard County (Bureau of the Census 1990a).

3.10 TRANSPORTATION

Interstate 24 passes through Paducah, Kentucky, approximately 16 km (10 miles) east of the Paducah Site. Four federal highways (US 45, 60, 62, and 68) and many state highways traverse the area. Main access to the plant is via US Highway 60. Because the Paducah Site is located in a secured area, traffic is minimal within the plant and surrounding area and generally is limited to trucks or service vehicles that move equipment and supplies within the facility. Rail access is available on-site at the Paducah Site.

3.10.1 Transportation Routes from the Paducah Site

Wastes are transported in approved DOT, NRC, and DOE containers that meet the requirements of the waste receiver (see Sect. 4.1.2 for assumptions relating to waste types and containers). The proposed action would adhere to these requirements. If LLW were transported by commercial truck, the waste would be transported along interstate highways or other primary highways well suited to cargo-truck transport. If waste were transported by rail, existing commercial rail routes and schedules would be used.

3.10.2 Truck Routes from the Paducah Site to Treatment and Disposal Sites

The highway route characteristics from the Paducah Site to the representative treatment and proposed disposal sites in the proposed action are provided in Table 3.4. Table 3.5 shows the population along the representative routes.

Table 3.4. Highway route distances from the Paducah Site to each proposed destination

Destination	Rural distance (miles)	Suburban distance (miles)	Urban distance (miles)	Total distance (miles)
Andrews, TX	943.4	171.7	11.9	1127.0
Deer Park, TX	711.5	171.9	13.5	897.0
Hanford, WA	1977.8	206.0	23.1	2207.0
Clive, UT	1497.7	163.8	29.5	1691.0
Mercury, NV	1648.2	187.1	25.0	1861.0
Oak Ridge, TN	252.5	54.8	2.7	310.0
Atomic City, ID	1594.9	175.6	20.4	1791.0

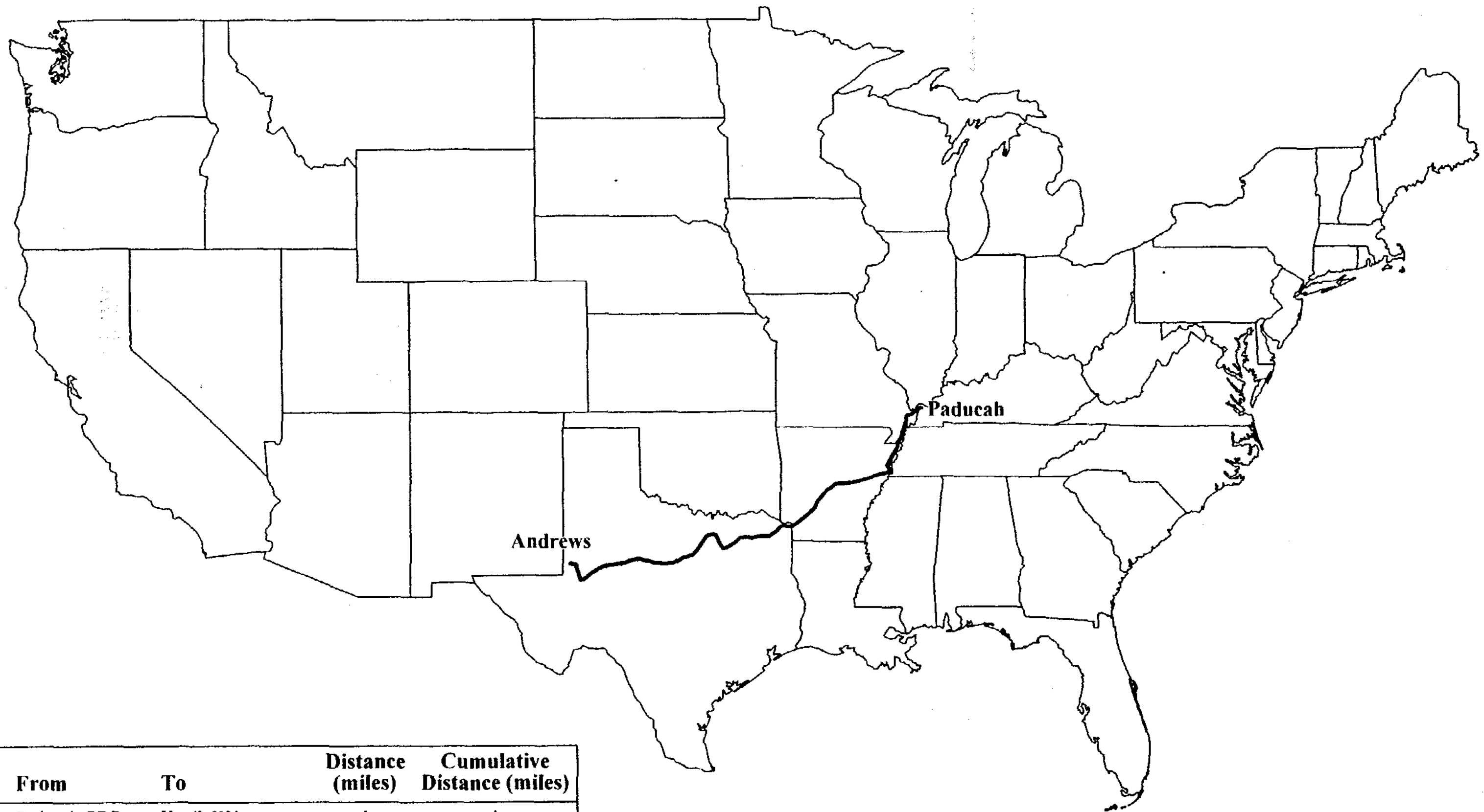
Source: Highway 3.4 code

Table 3.5. Potentially exposed populations along highway routes from the Paducah Site to each proposed destination

Route to	Potentially exposed population*
Andrews, TX	241,841
Deer Park, TX	236,130
Hanford, WA	353,676
Clive, UT	346,071
Mercury, NV	334,455
Oak Ridge, TN	56,958
Atomic City, ID	340,497

*Derived using population densities along highway links (source: Highway 3.4 code).

Representative highway transportation routes between the Paducah Site and proposed disposal destinations are outlined in Figs. 3.2 through 3.7. Routes were selected using TRAGIS® software. A



Roadway	From	To	Distance (miles)	Cumulative Distance (miles)
Local	Paducah GDP	Kevil, KY	4	4
U60	Kevil	Wickliffe, KY	19	23
U51	Wickliffe	Cairo, IL	5	28
I-57	Cairo	Charleston, MO	12	40
I-55	Charleston	Sikeston, MO	13	53
I-55	Sikeston	Hayti, MO	49	102
I-55	Hayti	West Memphis, AR	83	185
I-40	West Memphis	Galloway, AR	118	303
I-30	Galloway	Little Rock, AR	10	313
I-30	Little Rock	Texarkana, AR	136	449
I-30	Texarkana	Dallas, TX	179	628
I-35	Dallas	Dallas	.5	629
I-20	Dallas	White Settlement, TX	45	674
I-20	White Settlement	Odessa, TX	304	978
U385	Odessa	Andrews, TX	36	1014
S176	Andrews	Andrews	31	1045
S176	Andrews	WCS Site, TX	1	1046

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Fig. 3.2. Representative route for transportation of waste by truck from Paducah, Kentucky, to Andrews, Texas.

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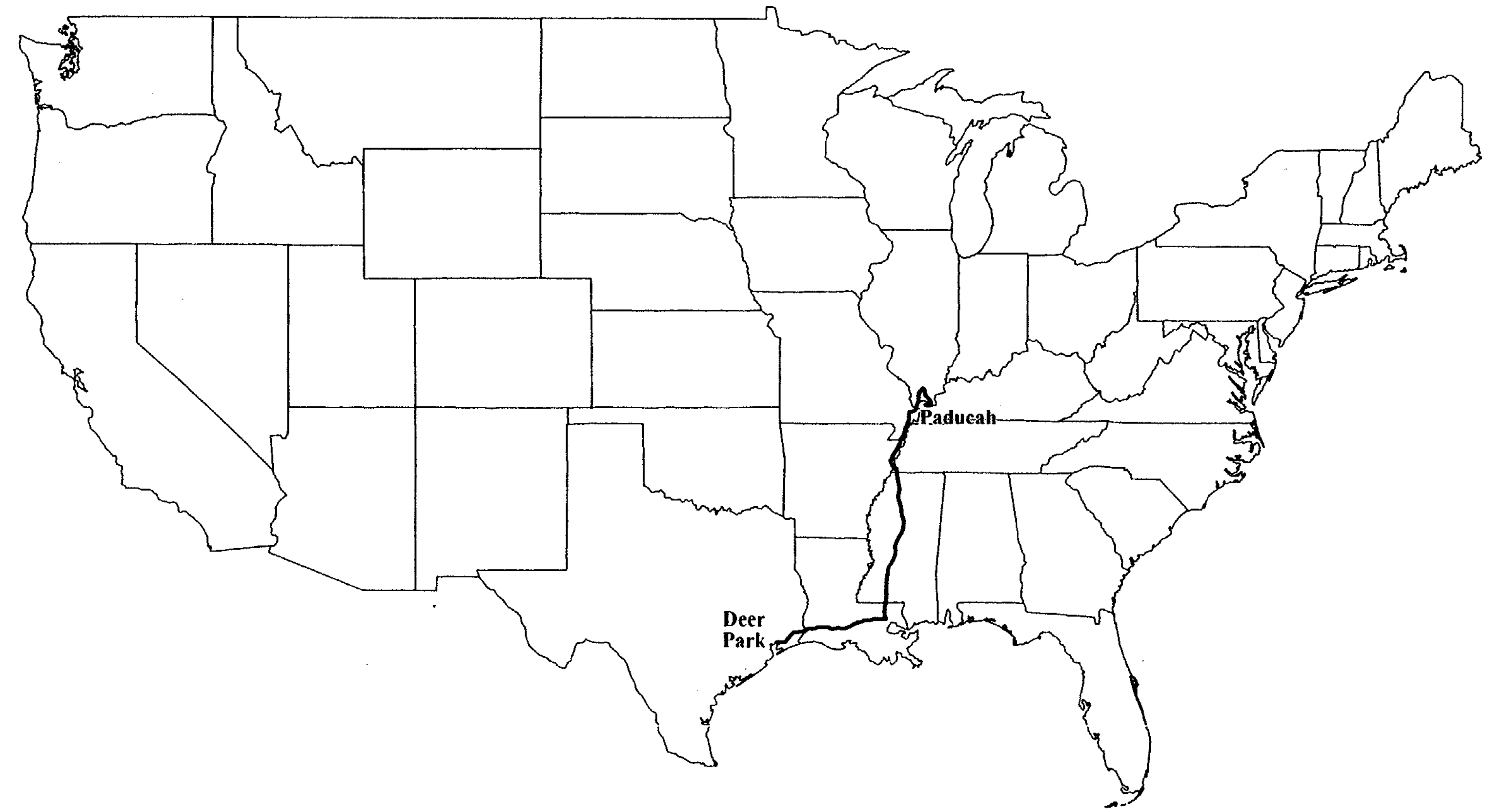

Roadway	From	To	Distance (miles)	Cumulative Distance (miles)
I-24	Paducah	Pulleys Mill, IL	44	55
I-57	Pulleys Mill	Sikeston, MO	67	122
I-55	Sikeston	W. Memphis, AR	131	253
I-55	W. Memphis	Jackson, MS	213	469
I-20	Jackson	Hammond, LA	128	597
I-55	Hammond	Baton Rouge, LA	38	635
I-12	Baton Rouge	Channelview, TX	258	893
I-10	Channelview	Deer Park, TX	4	897

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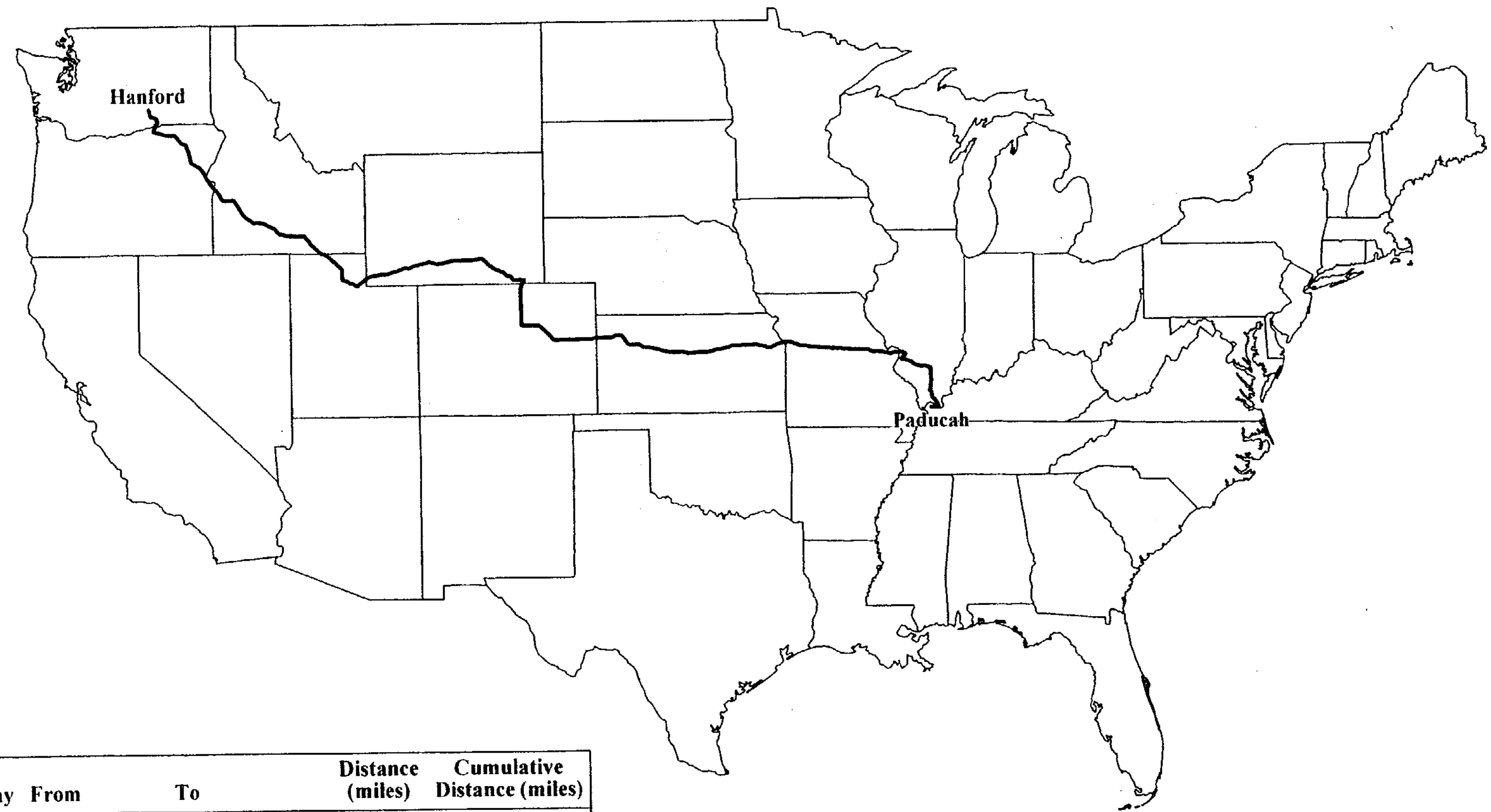
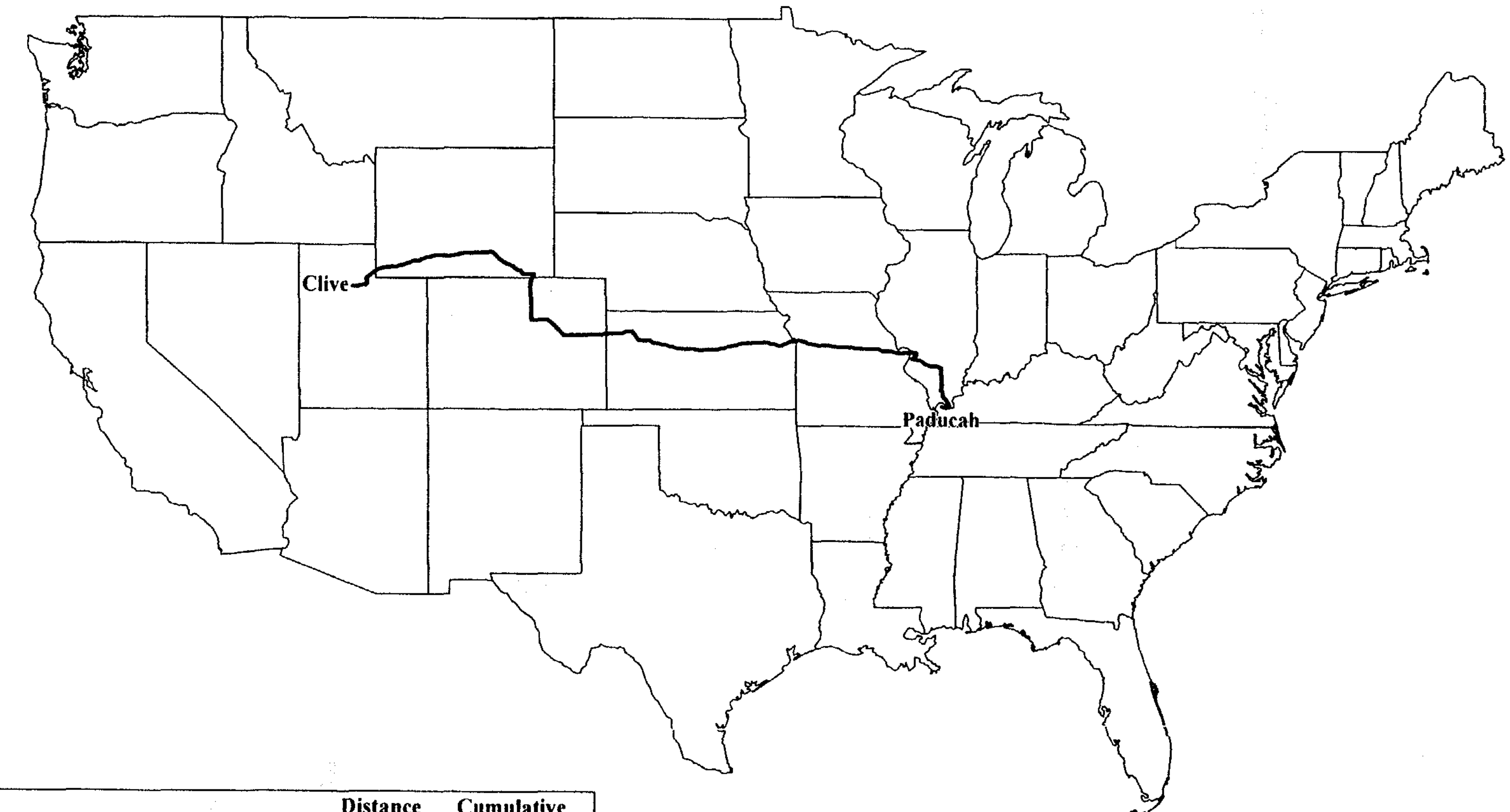
Fig. 3.3. Representative route for transportation of waste by truck from Paducah, Kentucky, to Deer Park, Texas.



Roadway	From	To	Distance (miles)	Cumulative Distance (miles)
I-24	Paducah	Pulleys Mill, IL	44	55
I-57	Pulleys Mill	Mt. Vernon, IL	48	103
I-65	Mt. Vernon	Washington PK, IL	67	175
I-255	Washington PK	Edwardsville, IL	11	186
I-270	Edwardsville	St. Louis, MO	22	208
I-270	St. Louis	Kansas City, KS	224	432
I-435	Kansas City	Bonner Springs, KS	4	467
I-70	Bonner Springs	Topeka, KS	42	521
I-70	Topeka	Denver, CO	526	1047
I-270	Denver	Commerce City, CO	5	1052
I-25	Commerce City	Cheyenne, WY	91	1144
I-80	Cheyenne	Echo, UT	389	1533
I-84	Echo	Ogden, UT	39	1572
I-84	Ogden	Tremonton, UT	39	1611
I-84	Tremonton	Hermiston, OR	11	2180
I-84	Hermiston	W. Richland, WA	41	2164
I-82	W. Richland	Richland, WA	5	2176
S-240	Richland	Hanford, WA	11	2180

Fig. 3.4. Representative route for transportation of waste by truck from Paducah, Kentucky, to Hanford, Washington.



Roadway	From	To	Distance (miles)	Cumulative Distance (miles)
I-24	Paducah	Pulleys Mill, IL	44	55
I-57	Pulleys Mill	Mt. Vernon, IL	48	103
I-65	Mt. Vernon	Washington PK, IL	67	175
I-255	Washington PK	Edwardsville, IL	11	186
I-270	Edwardsville	St. Louis, MO	22	208
I-270	St. Louis	Kansas City, KS	224	432
I-435	Kansas City	Bonner Springs, KS	4	467
I-70	Bonner Springs	Topeka, KS	42	521
I-70	Topeka	Denver, CO	526	1047
I-270	Denver	Commerce City, CO	5	1052
I-25	Commerce City	Cheyenne, WY	91	1144
I-80	Cheyenne	Holladay, UT	427	1571
I-215	Holladay	Salt Lake City, UT	22	1593
I-215	Salt Lake City	Argonite, UT	62	1655
I-80	Argonite	Clive, UT	9	1664

57-121800-019 F

Fig. 3.5. Representative route for transportation of waste by truck from Paducah, Kentucky, to Clive, Utah.

Roadway	From	To	Distance (miles)	Cumulative Distance (miles)
I-24	Paducah	Pulleys Mill, IL	44	55
I-57	Pulleys Mill	Mt. Vernon, IL	48	103
I-65	Mt. Vernon	Washington PK, IL	67	175
I-255	Washington PK	Edwardsville, IL	11	186
I-270	Edwardsville	St. Louis, MO	22	208
I-270	St. Louis	Kansas City, KS	224	432
I-435	Kansas City	Bonner Springs, KS	4	467
I-70	Bonner Springs	Topeka, KS	42	521
I-70	Topeka	Denver, CO	538	1059
I-25	Denver	Cheyenne, WY	101	1160
I-80	Cheyenne	West Wendover, NV	562	1722
US-93	West Wendover	Ely, NV	123	1845
US-6	Ely	Tonopah, NV	166	2011
US-95	Tonopah	Mercury, NV	116	2127

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Fig. 3.6. Representative route for transportation of waste by truck from Paducah, Kentucky, to Mercury, Nevada.

Roadway	From	To	Distance (miles)	Cumulative Distance (miles)
I-24	Paducah	Inglewood, TN	135	146
I-24	Inglewood	Nashville, TN	5	151
I-40	Nashville	Lenoir City, TN	152	305
I-40	Lenoir City	X-10	3	308
S-95	X-10	ORNL	2	310

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Fig. 3.7. Representative route for transportation of waste by truck from Paducah, Kentucky, to Oak Ridge, Tennessee.

comparison was performed between shortest-distance and shortest-time routes. Little difference was identified. Therefore, shortest distance routes were used for analysis.

The following constraints were applied in truck route selection:

1. avoidance of road segments prohibiting truck use,
2. following of HM-164/state-preferred routes for high-level radioactive waste,
3. avoidance of ferry crossings, and
4. avoidance of access roads between nonintersecting interstate highways.

Waste treatment may be conducted at the Paducah Site or at broad spectrum contractors. The route outlined in Fig. 3.4 serves as a representative route to any of several commercial treatment facilities in the Oak Ridge, Tennessee area.

3.10.3 Rail Routes from the Paducah Site to Treatment and Disposal Sites

Representative rail routes between the Paducah Site and proposed disposal destinations are shown in Figs. 3.8 through 3.13. The rail routes to Nevada, Texas, and Idaho do not terminate at the same location as the truck routes. However, the rail routes do end within the boundaries of the receiving sites.

Table 3.6 provides the characteristics of the proposed rail routes. The total potentially exposed populations residing along the rail routes are estimated in Table 3.7.

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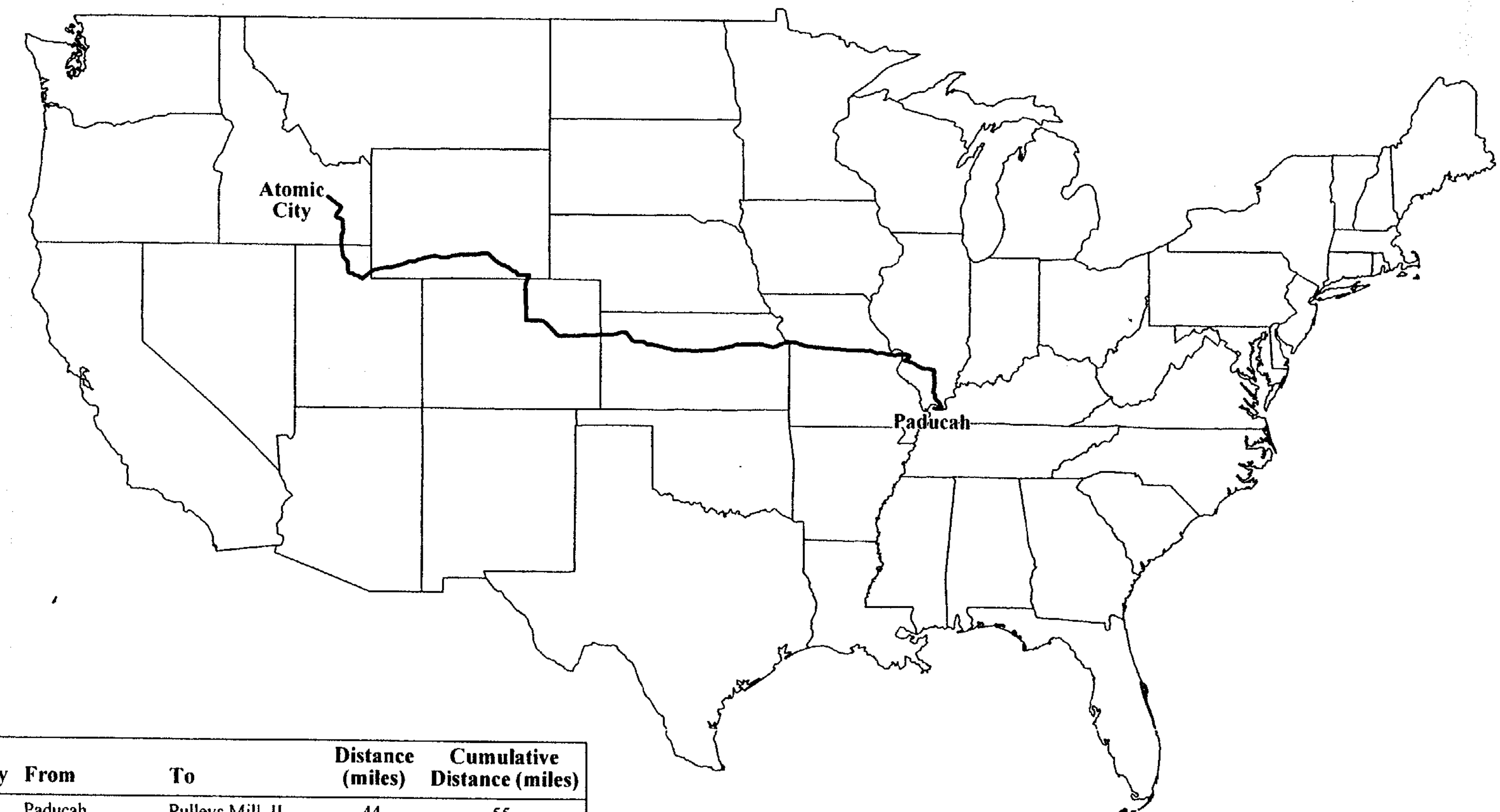

Roadway	From	To	Distance (miles)	Cumulative Distance (miles)
I-24	Paducah	Pulleys Mill, IL	44	55
I-57	Pulleys Mill	Mt. Vernon, IL	48	103
I-65	Mt. Vernon	Washington PK, IL	67	175
I-255	Washington PK	Edwardsville, IL	11	186
I-270	Edwardsville	St. Louis, MO	22	208
I-270	St. Louis	Kansas City, KS	224	432
I-435	Kansas City	Bonner Springs, KS	4	467
I-70	Bonner Springs	Topeka, KS	42	521
I-70	Topeka	Denver, CO	526	1047
I-270	Denver	Commerce City, CO	5	1052
I-76	Commerce City	Cheyenne, WY	91	1144
I-80	Cheyenne	Echo, UT	389	1533
I-15	Echo	Ogden, UT	39	1572
I-84	Ogden	Tremonton, UT	39	1611
I-15	Tremonton	Blackfoot, ID	112	1723
U26	Blackfoot	Atomic City, ID	36	1759
U20	Atomic City	ID Natl Eng Lab	5	1764

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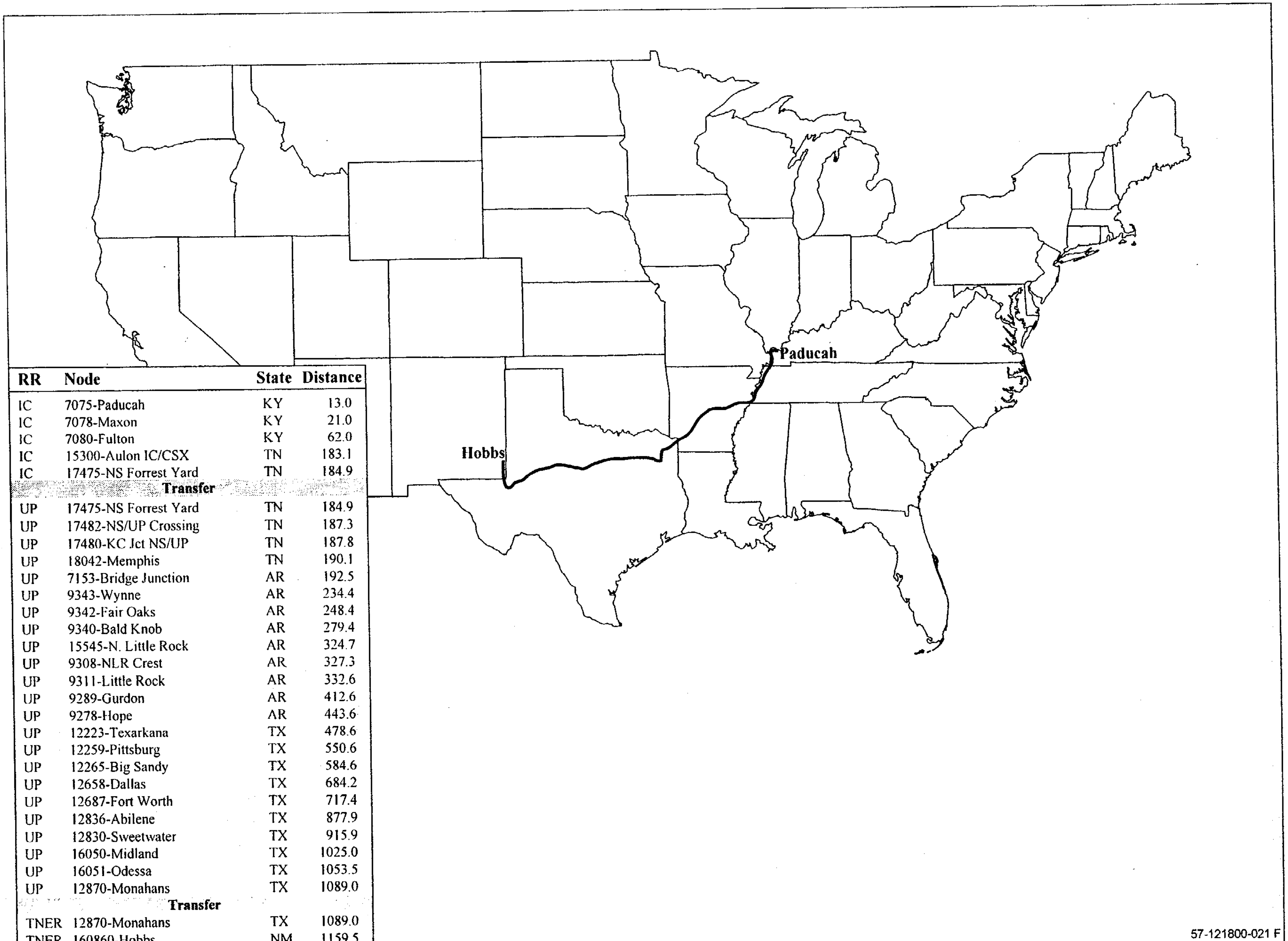
Fig. 3.8. Representative route for transportation of waste by truck from Paducah, Kentucky, to Atomic City, Idaho.



RR	Node	State	Distance
IC	7075-Paducah	KY	13.0
IC	7078-Maxon	KY	21.0
IC	7080-Fulton	KY	62.0
IC	15300-Aulon IC/CSX	TN	183.1
IC	17475-NS Forrest Yard	TN	184.9
	Transfer		
UP	17475-NS Forrest Yard	TN	184.9
UP	17482-NS/UP Crossing	TN	187.3
UP	17480-KC Jct NS/UP	TN	187.8
UP	18042-Memphis	TN	190.1
UP	7153-Bridge Junction	AR	192.5
UP	9343-Wynne	AR	234.4
UP	9342-Fair Oaks	AR	248.4
UP	9340-Bald Knob	AR	279.4
UP	15545-N. Little Rock	AR	324.7
UP	9308-NLR Crest	AR	327.3
UP	9311-Little Rock	AR	332.6
UP	9289-Gurdon	AR	412.6
UP	9278-Hope	AR	443.6
UP	12223-Texarkana	TX	478.6
UP	12259-Pittsburg	TX	550.6
UP	12265-Big Sandy	TX	584.6
UP	12658-Dallas	TX	684.2
UP	12687-Fort Worth	TX	717.4
UP	12836-Abilene	TX	877.9
UP	12830-Sweetwater	TX	915.9
UP	16050-Midland	TX	1025.0
UP	16051-Odessa	TX	1053.5
UP	12870-Monahans	TX	1089.0
	Transfer		
TNER	12870-Monahans	TX	1089.0
TNER	160860-Hobbs	NM	1159.5

Fig. 3.9. Representative route for transportation of waste by rail from Paducah, Kentucky, to Hobbs, New Mexico.

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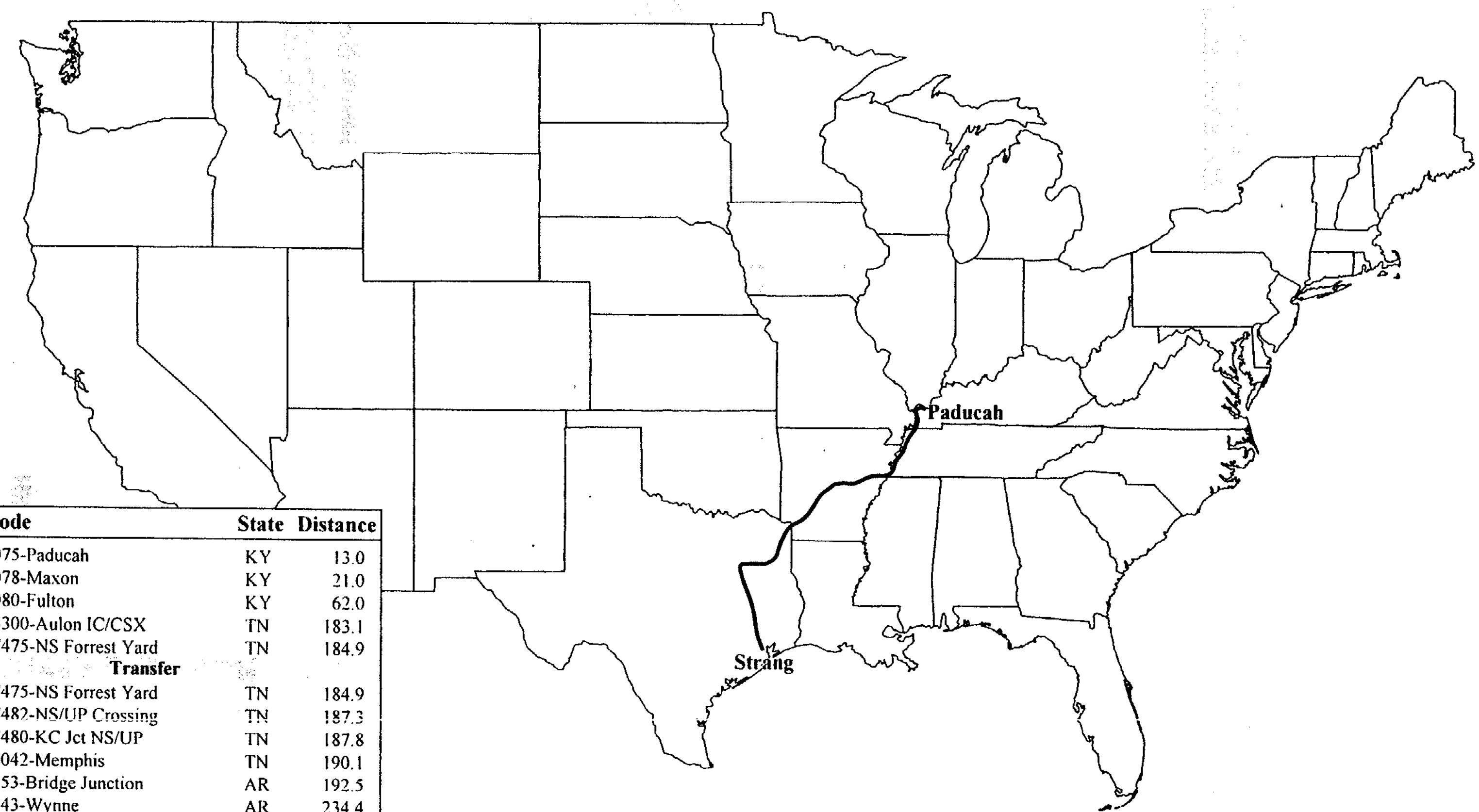

RR	Node	State	Distance
IC	7075-Paducah	KY	13.0
IC	7078-Maxon	KY	21.0
IC	7080-Fulton	KY	62.0
IC	15300-Aulon IC/CSX	TN	183.1
IC	17475-NS Forrest Yard	TN	184.9
	Transfer		
UP	17475-NS Forrest Yard	TN	184.9
UP	17482-NS/UP Crossing	TN	187.3
UP	17480-KC Jct NS/UP	TN	187.8
UP	18042-Memphis	TN	190.1
UP	7153-Bridge Junction	AR	192.5
UP	9343-Wynne	AR	234.4
UP	9342-Fair Oaks	AR	248.4
UP	9340-Bald Knob	AR	279.4
UP	15545-N. Little Rock	AR	324.7
UP	9308-NLR Crest	AR	327.3
UP	9311-Little Rock	AR	332.6
UP	9289-Gurdon	AR	412.6
UP	9278-Hope	AR	443.6
UP	12223-Texarkana	TX	478.6
UP	12261-Jefferson	TX	529.6
UP	12262-Marshall	TX	545.6
UP	12264-Longview	TX	568.6
UP	12484-Palestine	TX	650.5
UP	12396-Conroe	TX	762.5
UP	12398-Spring	TX	778.5
UP	12399-Houston	TX	802.6
UP	12393-Strang	TX	828.4

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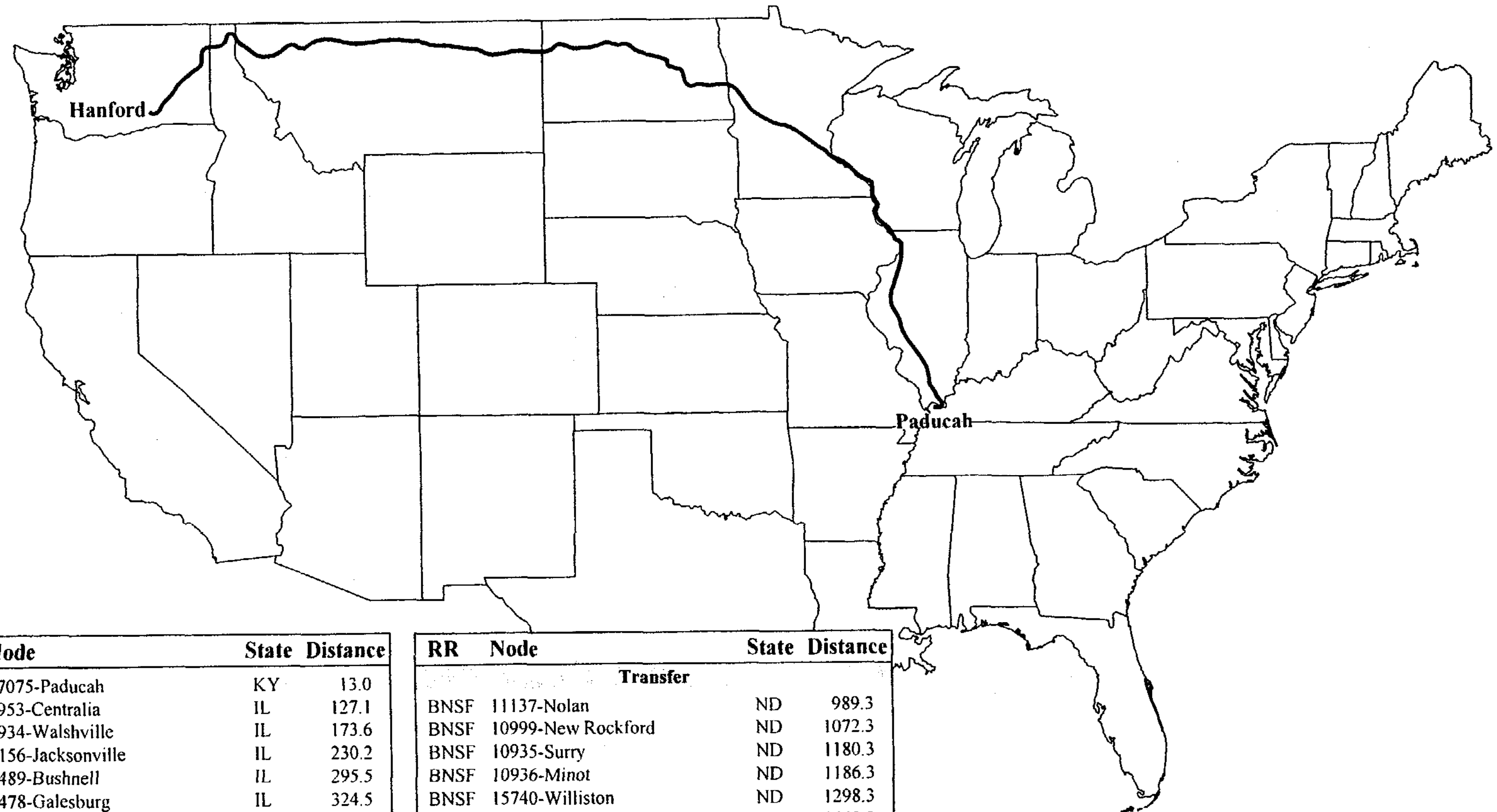
Fig. 3.10. Representative route for transportation of waste by rail from Paducah, Kentucky, to Strang, Texas.



RR	Node	State	Distance
BNSF	77075-Paducah	KY	13.0
BNSF	4953-Centralia	IL	127.1
BNSF	4934-Walshville	IL	173.6
BNSF	5156-Jacksonville	IL	230.2
BNSF	4489-Bushnell	IL	295.5
BNSF	4478-Galesburg	IL	324.5
BNSF	4317-Savanna	IL	420.5
BNSF	4327-E. Dubuque	IL	460.5
BNSF	5736-La Crosse	WI	571.5
BNSF	9814-Hastings	MN	665.5
BNSF	9830-St.Paul	MN	692.7
BNSF	9800-Westminster St.	MN	693.7
BNSF	9793-SOO Line Jct.	MN	695.2
BNSF	15603-E. Minneapolis	MN	702.6
BNSF	15605-Shoreham	MN	705.4
BNSF	9798-Northtown Yard	MN	708.0
BNSF	9826-Coon Creek	MN	713.3
BNSF	9671-Sauk Rapids	MN	763.3
BNSF	9663-Staples	MN	828,3
BNSF	9578-Detroit Lakes	MN	894.3
BNSF	11131-Moorhead	MN	942.3
BNSF	11132-Fargo	ND	945.3
BNSF	11134-Casselton	ND	965.3

RR	Node	State	Distance
	Transfer		
BNSF	11137-Nolan	ND	989.3
BNSF	10999-New Rockford	ND	1072.3
BNSF	10935-Surry	ND	1180.3
BNSF	10936-Minot	ND	1186.3
BNSF	15740-Williston	ND	1298.3
BNSF	13190-Glasgow	MT	1463.3
BNSF	13168-Havre	MT	1617.3
BNSF	13089-Shelby	MT	1718.3
BNSF	13077-Whitefish	MT	1880.3
BNSF	13299-Bonner's Ferry	ID	2029.3
BNSF	13300-Sandpoint	ID	2067.3
BNSF	13304-Hauser	ID	2118.3
BNSF	13828-Spokane	WA	2137.6
BNSF	13821-Fish Lake	WA	2150.9
BNSF	13890-Pasco	WA	2285.4
BNSF	13964-Kennewick	WA	2286.6
BNSF	13941-Richland	WA	2295.2
	Transfer		
USG	13941-Richland	WA	2295.2
USG	16212-Hanford	WA	2302.9

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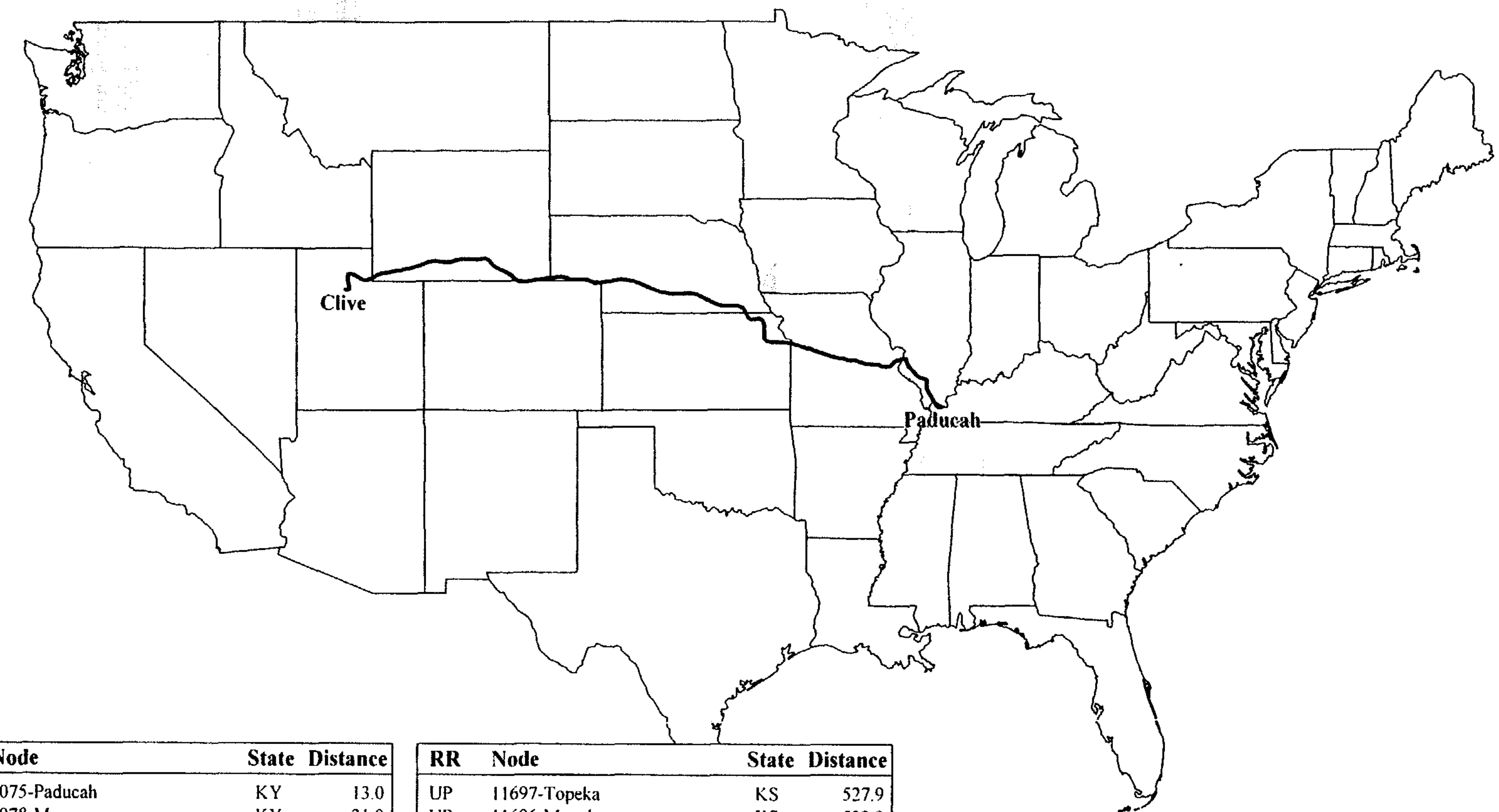
Fig. 3.11. Representative route for transportation of waste by rail from Paducah, Kentucky, to Hanford, Washington.



RR	Node	State	Distance
IC	7075-Paducah	KY	13.0
IC	7078-Maxon	KY	21.0
IC	5079-Du Quoin	IL	117.1
IC	5077-Pinckneyville	IL	127.1
IC	10867-Viner	IL	180.1
IC	10827-Valley Jct	IL	181.7
IC	10859-E. St. Louis	IL	183.6
	Transfer		
UP	10859-E. St. Louis	IL	183.6
UP	10858-St. Louis	MO	184.6
UP	10875-Grand Ave (St. Louis)	MO	187.4
UP	10860-Pacific	MO	211.4
UP	10656-Jefferson City	MO	309.4
UP	10627-Pleasant Hill	MO	425.5
UP	15708-Sheffield	MO	453.1
UP	15709-Kansas City Union Station	MO	458.1
UP	10617-Kansas City	KS	459.1
UP	11823-Lawrence	KS	497.9

RR	Node	State	Distance
UP	11697-Topeka	KS	527.9
UP	11696-Menoken	KS	532.9
UP	11681-Marysville	KS	607.9
UP	11487-Endicott	NE	639.9
UP	11405-Hastings	NE	715.9
UP	11410-Gibbon	NE	741.9
UP	11352-North Platte	NE	861.0
UP	11358-O'Fallon	NE	872.4
UP	13703-Julesburg	CO	940.4
UP	11287-Sidney	NE	983.4
UP	13465-Cheyenne	WY	1086.4
UP	13462-Laramie	WY	1138.4
UP	13494-Granger	WY	1414.4
UP	13568-Ogden	UT	1557.5
UP	13595-Salt Lake City	UT	1593.0
UP	13594-Garfield	UT	1605.1
UP	13524-Clive	UT	1667.1

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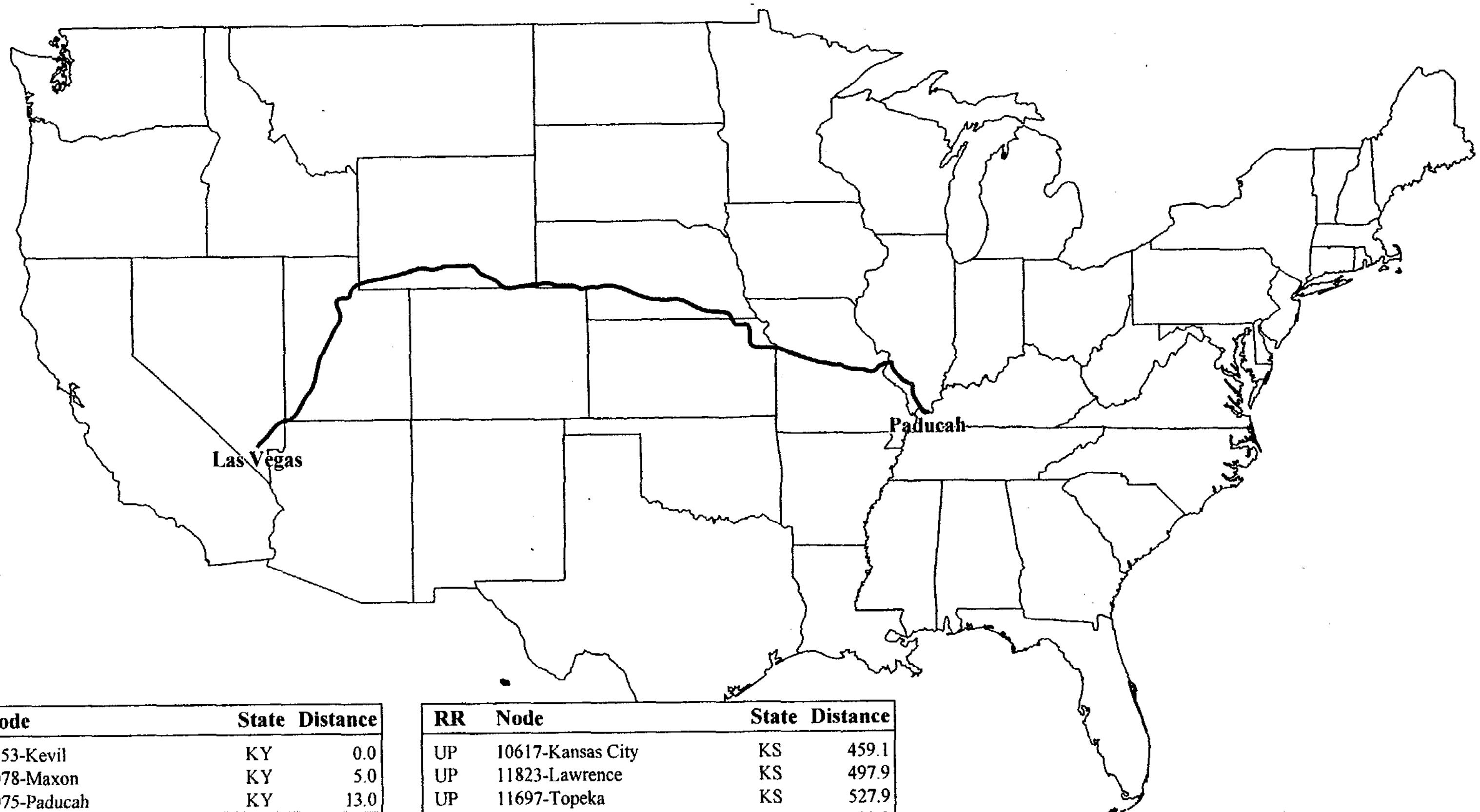
Fig. 3.12. Representative route for transportation of waste by rail from Paducah, Kentucky, to Clive, Utah.



RR	Node	State	Distance
PAL	7053-Kevil	KY	0.0
PAL	7078-Maxon	KY	5.0
PAL	7075-Paducah	KY	13.0
	Transfer		
IC	7075-Paducah	KY	13.0
IC	7078-Maxon	KY	21.0
IC	5079-Du Quoin	IL	117.1
IC	5077-Pinckneyville	IL	127.1
IC	10867-Viner	IL	180.1
IC	10827-Valley Jct	IL	181.7
IC	10859-E. St. Louis	IL	183.6
	Transfer	IL	
UP	10859-E. St. Louis	IL	183.6
UP	10858-St. Louis	MO	184.6
UP	10875-Grand Ave (St. Louis)	MO	187.4
UP	10860-Pacific	MO	211.4
UP	10656-Jefferson City	MO	309.4
UP	10627-Pleasant Hill	MO	425.5
UP	15708-Sheffield	MO	453.1
UP	15709-Kansas City Union Station	MO	458.1

RR	Node	State	Distance
UP	10617-Kansas City	KS	459.1
UP	11823-Lawrence	KS	497.9
UP	11697-Topeka	KS	527.9
UP	11696-Menoken	KS	532.9
UP	11681-Marysville	KS	607.9
UP	11487-Endicott	NE	639.9
UP	11405-Hastings	NE	715.9
UP	11410-Gibbon	NE	741.9
UP	11352-North Platte	NE	861.0
UP	11358-O'Fallon	NE	872.4
UP	13703-Julesburg	CO	940.4
UP	11287-Sidney	NE	983.4
UP	13465-Cheyenne	WY	1086.4
UP	13462-Laramie	WY	1138.4
UP	13494-Granger	WY	1414.4
UP	13568-Ogden	UT	1557.5
UP	13595-Salt Lake City	UT	1593.0
UP	13594-Garfield	UT	1605.1
UP	13630-Lynndyl	UT	1708.1
UP	Las Vegas	NV	2032.9

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Fig. 3.13. Representative route for transportation of waste by rail from Paducah, Kentucky, to Las Vegas, Nevada.

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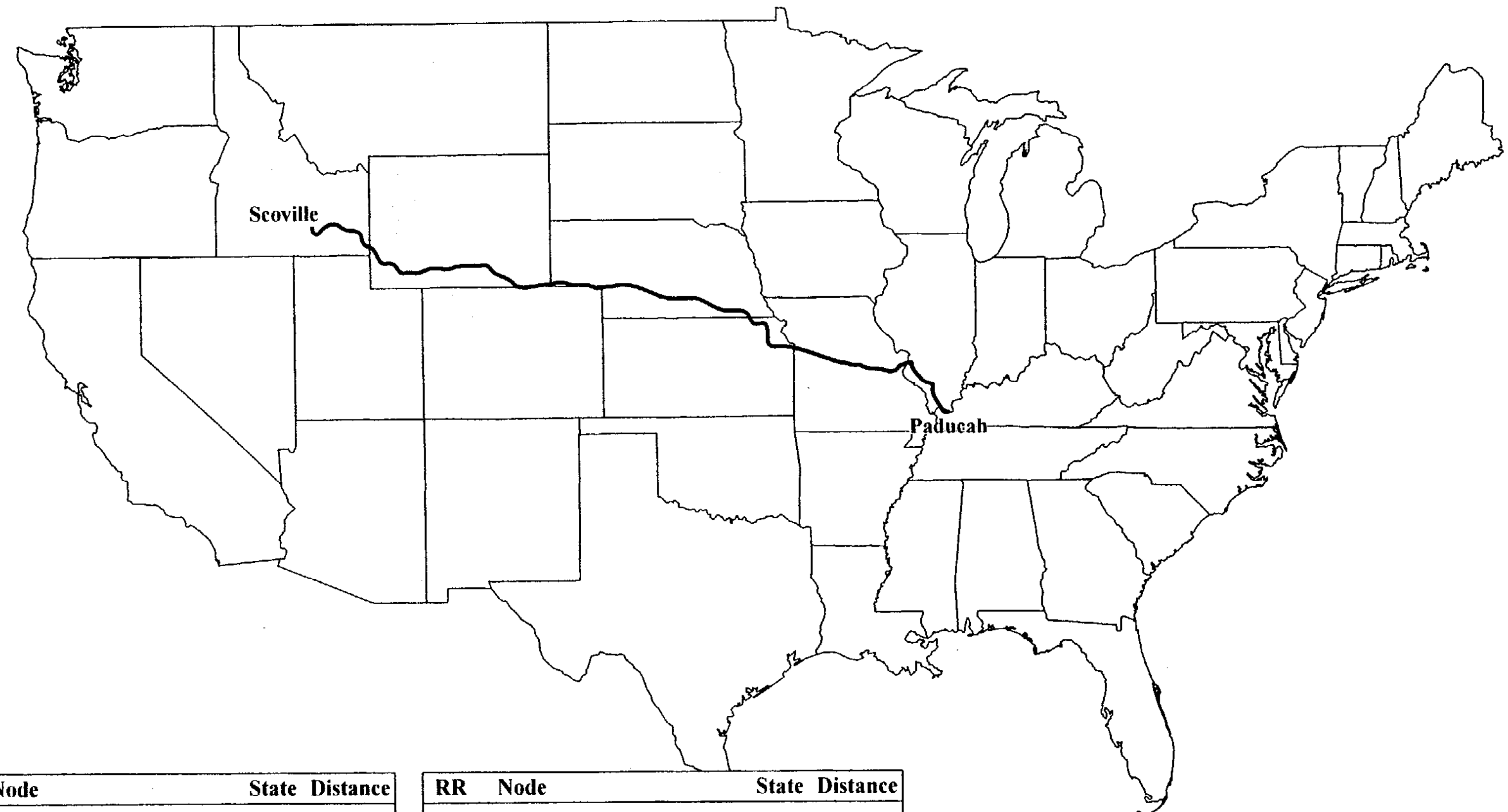
RR	Node	State	Distance
PAL	7075-Paducah	KY	13.0
PAL	7059-Madisonville	KY	91.0
PAL	15293-Central City	KY	111.2
PAL	7008-Louisville	KY	235.0
	Transfer		
NS	7008-Louisville	KY	235.0
NS	6979-Danville	KY	335.0
NS	7260-Harriman	TN	496.8
NS	15317-Blair	TN	506.3
	Transfer		
C3	15317-Blair	TN	506.3
C3	15316-K 25	TN	511.8

Fig. 3.14. Representative route for transportation of waste by rail from Paducah, Kentucky, to Oak Ridge, Tennessee.



RR	Node	State	Distance
IC	7075-Paducah	KY	13.0
IC	7078-Maxon	KY	21.0
IC	5079-Du Quoin	IL	117.1
IC	5077-Pinckneyville	IL	127.1
IC	10867-Viner	IL	180.1
IC	10827-Valley Jct	IL	181.7
IC	10859-E. St. Louis	IL	183.6
	Transfer		
UP	10859-E. St. Louis	IL	183.6
UP	10858-St. Louis	MO	184.6
UP	10875-Grand Ave (St. Louis)	MO	187.4
UP	10860-Pacific	MO	211.4
UP	10656-Jefferson City	MO	309.4
UP	10627-Pleasant Hill	MO	425.5
UP	15708-Sheffield	MO	453.1
UP	15709-Kansas City Union Station	MO	458.1
UP	10617-Kansas City	KS	459.1

RR	Node	State	Distance
UP	11823-Lawrence	KS	497.9
UP	11697-Topeka	KS	527.9
UP	11696-Menoken	KS	532.9
UP	11681-Marysville	KS	607.9
UP	11487-Endicott	NE	639.9
UP	11405-Hastings	NE	715.9
UP	11410-Gibbon	NE	741.9
UP	11352-North Platte	NE	861.0
UP	11358-O'Fallon	NE	872.4
UP	13703-Julesburg	CO	940.4
UP	11287-Sidney	NE	983.4
UP	13465-Cheyenne	WY	1086.4
UP	13462-Laramie	WY	1138.4
UP	13494-Granger	WY	1414.4
UP	13369-McCammon	ID	1607.7
UP	13370-Pocatello	ID	1630.7
UP	13336-Scoville	ID	1686.7

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Fig. 3.15. Representative route for transportation of waste by rail from Paducah, Kentucky, to Scoville, Idaho.

Table 3.6. Rail route distances from the Paducah Site to each proposed destination[a]

Destination	Rural distance (miles)	Suburban distance (miles)	Urban distance (miles)	Total distance (miles)
Hobbs, NM	1064.4	216.5	27.7	1308.6
Strang, TX	1064.4	216.5	27.7	1308.6
Hanford, WA	1775.1	208.5	32.5	2016.1
Clive, UT	1575.4	187.9	31.5	1794.8
Las Vegas, NV	1956.8	189.6	34.3	2180.7
Oak Ridge, TN[b]	402.8	77.4	15.4	495.6
Scoville, ID	1679.2	178.1	28.6	1885.9

[a]*Source*: Interline Data Network 15.0.
[b]Oak Ridge destinations (Oak Ridge National Laboratory, East Tennessee Technology Park, and Materials & Energy/Waste Control Specialists).

Table 3.7. Potentially exposed populations along railway routes from the Paducah Site to each proposed destination

Route to	Potentially exposed population[a]
Hobbs, NM	380,284
Strang, TX	380,284
Hanford, WA	409,207
Clive, UT	381,473
Las Vegas, NV	413,971
Oak Ridge, TN[b]	168,524
Scoville, ID	342,689

[a]Derived using population densities along railway links (Source: Interline Data Network 15.0).
[b]Oak Ridge destinations (Oak Ridge National Laboratory, East Tennessee Technology Park, and Materials & Energy/Waste Control Specialists).

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4. ENVIRONMENTAL CONSEQUENCES

4.1 IMPACTS OF THE PROPOSED ACTION

Potential impacts resulting from the proposed action are presented in five sections: (1) impacts to Paducah Site area resources, (2) potential impacts to human health from an onsite accident, (3) impacts resulting from off-site transportation, (4) impacts resulting from on-site treatment, and (5) impacts from DMSA characterization.

4.1.1 Resource Impacts

The following sections present potential impacts to Paducah Site and area resources resulting from proposed waste disposition activities.

4.1.1.1 Land use

Waste Storage. In the proposed action, waste would continue to be stored in the current locations. This would result in no changes in land use.

Waste Treatment. Waste treatment would be performed at Bldg. C-752-A. This building is now used for industrial purposes, and the proposed action would not change this classification. The proposed action and the implementation of treatment technologies different from those now being performed would result in a minor modification to the current use for this building. This building is currently being used for other waste treatment activities that have been covered under separate analysis.

Building C-746-A is the proposed location for physical volume reduction of waste. This building is currently being used for this purpose, so no change in use would occur.

Under the proposed action, a portion of the wastes is proposed for off-site treatment at existing, licensed/permitted facilities. This would result in no anticipated impacts at the Paducah Site.

Waste Disposal. Under normal operations of the proposed action, all of the wastes are proposed to be disposed off-site at existing, licensed/permitted facilities. Therefore, no impacts are anticipated at the Paducah Site.

Supporting Activities. Supporting activities are currently being performed at the site and take place within the Paducah Site boundaries. The continuation of these activities would have no impact on land use.

4.1.1.2 Geology and seismicity

Waste Storage. Under the proposed action, waste would continue to be stored in the current locations. Continuation of normal operations would result in no impacts to the site geology. Storage accidents, such as a spill, would likely not have an impact on the site geology due to mitigative measure that are in place, such as dikes and spill controls. However, should an accident occur that contaminates the soil, a small portion of the geology may be disturbed during spill cleanup should the area need to be excavated. Under this scenario, the impact is still estimated to be minor.

Impacts resulting from a seismological event are addressed in Sect. 4.1.2.

Waste Treatment. Neither normal operations nor a reasonable worst-case accident scenario for waste treatment would affect the site geology. Waste treatment would be performed at an existing building; therefore, no new excavation for construction is anticipated. Treatment accidents, such as a release during treatment, would likely not have an impact on the site geology due to mitigative measures that are in place, such as dikes and spill controls. However, should an accident occur that contaminates the soil, a small portion of the geology may be disturbed during spill cleanup should the area need to be excavated. Under this scenario, the impacts are still estimated to be minor and the probability of an accident is small.

Impacts from seismic events are addressed under Sect. 4.1.2.

Under the proposed action, a portion of the wastes is proposed for off-site treatment at existing, licensed, and/or permitted facilities. This would result in no anticipated impacts at the Paducah Site.

Waste Disposal. Under normal operations of the proposed action, all of the wastes are proposed to be disposed off-site at existing, licensed/permitted facilities. Therefore, no impacts resulting from disposal are anticipated at the Paducah Site.

Accidents related to transport of the waste to the disposal facility are addressed under Sect. 4.1.3.

Supporting Activities. The normal operations and continuation of supporting activities within the Paducah Site boundaries, which currently do not involve geological disturbance, would have no impact on the site geology. However, should an accident occur that contaminates the soil, a small portion of the geology may be disturbed during spill cleanup should the area need to be excavated. Under this scenario, the impacts are still estimated to be minor, since probability of an accident is small.

4.1.1.3 Soils and prime farmland

No prime farmlands are located within the Paducah Site boundary where waste disposition activities are proposed to occur. Therefore, impacts to prime farmlands are not anticipated from any waste disposition activity. The following discussion focuses on impacts to local soils only.

Waste Storage. Under the proposed action, waste would continue to be stored in the current locations. Continuation of normal operations would result in no impacts to the site soils. Storage accidents, such as a contaminant spill, would have minimal impact on soils due to mitigative measures that are in place, such as dikes and spill controls.

Waste Treatment. Neither normal operations nor a reasonable worst-case accident scenario described in Sect. 4.1.4 for on-site waste treatment would notably affect the site soils. Waste treatment would be performed at an existing building that is equipped with spill controls such as nonporous floors and dikes. Accidents, such as a release during treatment, would have minimal impact on the site soils due to the mitigative measures that were previously mentioned. Treatment facilities would have pertinent permits to control treatment processes.

Impacts to soils from activities related to wastes shipment off-site for treatment are addressed under Sect. 4.1.3.

Under the proposed action, a portion of the wastes is proposed for off-site treatment at existing, licensed, and/or permitted facilities. This would result in no anticipated impacts at the Paducah Site.

Waste Disposal. Under normal operations of the proposed action, all of the wastes are proposed to be disposed off-site at existing, licensed/permitted facilities. Therefore, no impacts are anticipated at the Paducah Site.

Accidents related to transport of the waste to the disposal facility are addressed under Sect. 4.1.3.

Supporting Activities. The normal operations and continuation of supporting activities within the Paducah Site boundaries would have no impact on the site soils. Accidents, such as a contaminant spill, would have minimal impact on soils due to mitigative measures that are in place, such as dikes and spill controls.

4.1.1.4 Water and water quality

Waste Storage. Normal waste storage operations should not result in the release of constituents at concentrations that would exceed water quality standards or other benchmarks. Long-term impacts to water quality would be beneficial after implementation of the proposed action because much of the on-site wastes would be removed from the site or repackaged and stored. When the current waste inventories are reduced or repackaged, potential releases of contaminants into the surface water are reduced, beneficially impacting the water quality.

Accident impacts to water quality from the reasonable worst-case, on-site accident scenario (earthquake) involving radionuclides are described in detail in Appendix C. Water quality in Bayou and Little Bayou creeks and other water conveyances by which the waste would reach the Ohio River could be adversely impacted in the short term because of the low pH of the waste and radiation exposure. However, the high flow volume of the Ohio River, averaged at 315,000 ft^3/sec (USGS 2001), would result in quick dilution of contaminants when the spill reached the river. No chemical or radionuclide contaminants would occur in the Ohio River at high enough concentrations to have adverse impacts to water quality according to the accident analysis. Thus, the earthquake scenario is likely to cause harm to water quality in creeks draining into the Ohio River, but Ohio River water quality should not be adversely impacted.

Waste Treatment. Although wastewater would be treated and released to existing outfalls, the treated water would meet the waste requirements for the on-site WWTP, so the water is not expected to exceed KPDES permit limits. No new contaminants are expected to be introduced to the WWTP, because the wastes described are consistent with waste historically produced at the site. Since the Paducah Site waste inventory would be maintained within the Paducah Site fence, potential impacts resulting from normal operations and treatment would be the same as for waste storage. See previous discussion for potential impacts to water resources in the area.

Under the proposed action, a portion of the wastes is proposed for off-site treatment at existing, licensed, and/or permitted facilities. This would result in no anticipated impacts at the Paducah Site.

Waste Disposal. Under normal operations of the proposed action, all of the wastes are proposed to be disposed off-site at existing, permitted and/or licensed facilities. These facilities were constructed with controls to contain the contamination within the facility. No impacts are anticipated at the Paducah Site.

Supporting Activities. The performance of supporting activities would potentially release the same waste constituents to the same water resources as discussed above in the waste storage section. No impacts are anticipated.

4.1.1.5 Groundwater, floodplains, and wetlands

No wetlands or floodplains are located within the Paducah Site boundary where waste disposition activities would occur. Therefore, no impacts to wetlands or floodplains are anticipated from any waste disposition activity. The following discussion focuses on groundwater impacts only.

Waste Storage. Continuation of normal waste storage operations would result in no impacts to the site groundwater. Storage accidents, such as spills, would have minimal impact on the groundwater due to mitigative measures that are in place, such as dikes and spill controls, and due to an estimated small release during the accident.

Waste Treatment. Neither normal operations nor a reasonable worst-case accident scenario for waste treatment would affect groundwater resources. Waste treatment would be performed at an existing building that is equipped with spill controls such as nonporous floors and dikes that would lower the risk of groundwater contamination. Accidents, such as a release during treatment, would have minimal impact on the groundwater due to these mitigative measures and to the estimated small release volume during an accident.

Impacts to groundwater related to wastes being transported for treatment are addressed under Sect. 4.1.3.

Under the proposed action, a portion of the wastes is proposed for off-site treatment at existing, licensed, and/or permitted facilities. This would result in no anticipated impacts at the Paducah Site.

Waste Disposal. Under normal operations of the proposed action, all of the wastes are proposed to be disposed off-site at existing, licensed/permitted facilities. These facilities were constructed with controls to contain the contamination within the facility; therefore, no impacts are anticipated at the Paducah Site.

Groundwater impacts related to accidents during transport of the waste to the disposal facility are addressed under Sect. 4.1.3.

Supporting Activities. The normal operations and continuation of supporting activities within the Paducah Site boundaries would have no impact on groundwater. Accidents that may occur during the performance of supporting activities would not have notable impact on groundwater due to mitigative measures and to the estimated small release during an accident.

4.1.1.6 Ecological resources

Normal operational activities associated with the proposed action would not adversely impact site vegetation or wildlife species at the Paducah Site. Accidents could result in some impacts to vegetation and wildlife resources in the area of occurrence. The indirect impacts from accidents to these resources could be derived from the movement of contamination through groundwater or surface water to these receptors. However, with the implementation of routine mitigative measures such as spill controls, the impacts are estimated to be minimal.

Aquatic Biota

Waste Storage. Under normal operations, waste storage impacts to aquatic biota from the proposed action should be negligible, because the on-site storage of wastes should not result in the release of constituents at concentrations that would be harmful to aquatic biota. Long-term impacts to aquatic biota would be beneficial after implementation of the proposed action, because much of the on-site waste would be removed from the site, reducing the amount stored on-site. When the current waste inventories are reduced, the potential exposure of aquatic biota is reduced, benefiting the biota.

The accident scenario description and impacts to aquatic biota from the reasonable worst-case accident (earthquake) scenario involving radionuclides are described in detail in Appendix C. As shown in Appendix C, Table C.1, the earthquake scenario is highly unlikely to cause harm to aquatic biota in the Ohio River as a result of exposure to radionuclides. However, aquatic receptors in Bayou and Little Bayou creeks and other water conveyances by which the waste would reach the Ohio River would suffer minor impacts resulting from the caustic nature of the waste. Radiation exposure could be of an acute nature.

Accident impacts to aquatic biota from the reasonable worst-case accident scenario (earthquake) involving nonradionuclides are described in Appendix C. As shown in Appendix C, Table C.2, PCBs are the only constituents whose ratio of concentration to toxicity benchmark (2.08) exceeds 1, indicating that PCBs could pose minor, short-term adverse impacts to aquatic biota, as well as in Bayou and Little Bayou creeks near the Kentucky bank of the Ohio River.

Waste Treatment. Short-term impacts to aquatic biota from the proposed action should be negligible, because the normal operation of on-site waste treatment should not result in the release of constituents at concentrations that would be harmful to aquatic biota. Although wastewater would be treated, the treated water would meet the waste requirements for the on-site WWTP. No notable adverse impacts resulting from the WWTP have been observed. Therefore, no negative impacts are expected to result form the additional treatment activities.

Long-term impacts to aquatic biota would be beneficial after implementation of the proposed action, because much of the on-site waste would be treated, resulting in a more stable waste form. When the current waste inventories are reduced, the potential exposure of aquatic biota is reduced.

Accident impacts to aquatic biota from the worst-case accident scenario (earthquake) are described in detail in Appendix C. The impacts are similar to the waste storage activity analysis because the waste constituents, receptors, and scenarios are the same. However, realistically, these impacts would be smaller, since the volume of waste defined for treatment is smaller than the waste storage volume. See discussion under the waste storage activity.

Under the proposed action, a portion of the wastes is proposed for off-site treatment at existing, licensed, and/or permitted facilities. This would result in no anticipated impacts at the Paducah Site.

Waste Disposal. Under normal operations of the proposed action, all of the wastes are proposed to be disposed off-site at existing, licensed/permitted facilities. Therefore, no impacts are anticipated at the Paducah Site.

Supporting Activities. The normal operations and accident impacts are identical to the waste storage activity analysis because the waste constituents, receptors, and scenarios are the same. See discussion under the waste storage activity. Accident impacts to aquatic biota from supporting activities under the worst-case accident scenario involving radionuclides are described in detail in Appendix C.

Terrestrial Biota

Waste Storage. Short-term waste storage impacts to terrestrial biota from normal operations of the proposed storage activity should be negligible because the repackaging and on-site maintenance of wastes should not result in the release of constituents at concentrations that would be harmful to the biota.

Impacts to terrestrial biota from the worst-case accident scenario (earthquake), along with soil concentrations, screening benchmarks, and results for individual radionuclides, are shown in Appendix C, Table C.1. The scenario for chronic radionuclide exposure indicates that in even this worst-case accident scenario, long-term radiation effects to soil biota would be negligible. As shown in Appendix C, Table C.2, two organics (PCBs and 1,2,4-trichlorobenzene) and two inorganics (cadmium and chromium) have modeled concentrations that would likely pose minor adverse impacts to soil biota if the worst-case spill accident occurred. However, these impacts would be reduced by the use of mitigative controls such as dikes, spill control measures, and cleanup.

Waste Treatment. Short-term waste treatment impacts to terrestrial biota from normal operations of the proposed action should be negligible because the repackaging and on-site treatment of wastes should not result in the release of constituents in concentrations that would be harmful to the biota.

Impacts resulting from radiological and nonradiological accidents would be identical to those discussed under waste storage because the same wastes would be released through the same scenarios to the same resources. See the waste storage section for discussion.

Under the proposed action, a portion of the wastes is proposed for off-site treatment at existing, licensed, and/or permitted facilities. This would result in no anticipated impacts at the Paducah Site.

Waste Disposal. Under normal operations of the proposed action, all of the wastes are proposed to be disposed off-site at existing, licensed/permitted facilities. Therefore, no impacts are anticipated at the Paducah Site.

Supporting Activities. Short-term impacts to terrestrial biota from activities executed to support waste management storage activity should be negligible because the maintenance of wastes should not result in the release of constituents at concentrations that would be harmful to the biota.

Impacts resulting from radiological and nonradiological accidents would be identical to those discussed under waste storage. This is true because the same wastes would be released through the same scenarios to the same resources. See the waste storage section for discussion.

4.1.1.7 Threatened and Endangered Species

No threatened or endangered species occur within the Paducah Site fence where the proposed action would take place. However, five species have been identified in the vicinity surrounding the site.

Indiana Bat. There is poor to fair summer habitat for the Indiana bat along portions of Bayou Creek to the west of the Paducah Site. The FWS (Barclay 1999) had several recommendations to protect the bats' habitat and food supply: (1) control erosion and maintain water quality in all streams, (2) minimize removal of mature riparian and upland forest; (3) create an equal amount of maternity or foraging habitat, should such habitat be lost; and (4) perform periodic inspections to ensure the protection of any habitat and the success of any mitigation.

No proposed operations or hypothesized accidents have been identified that would affect potential Indiana bat roosting or foraging habitat.

Mussel Species. Bayou Creek enters the Ohio River about 8 km (5 miles) downstream of the Paducah Site. Under normal operating conditions, any small quantities of PCBs released to a KPDES Outfall would not adversely affect the creeks or be expected to reach the Ohio River. However, if a highly unlikely or incredible accident were to occur, wastes might reach the Ohio River. During a flooding rainfall (which occurred less than once in 25 years), Bayou Creek, Little Bayou Creek, and the Ohio River would be flooded and sediments would move downstream. This would be a negligible addition to the concentration of contaminants already present in Ohio River sediments. This additional quantity of contaminants would be well within the measured variability of concentrations in river sediments. The addition of contaminants in the Ohio River would quickly (in minutes) pass mussel beds during flood conditions as sediments were moved rapidly downstream. An accidental release of contaminants would be extremely small and too brief to increase concentrations in the mussel species.

4.1.1.8 Noise

Waste Storage. Continuation of normal storage operations would result in no increase in the noise level of the area.

Waste Treatment. The proposed on-site waste treatment process does not include the use of large machinery, other than trucks for waste transport, or other noisy equipment. Therefore, the noise level is not anticipated to increase due to treatment activities.

Under the proposed action, a portion of the wastes is proposed for off-site treatment at existing, licensed, and/or permitted facilities. This would result in no anticipated impacts at the Paducah Site. Impacts to the noise environment from activities related to wastes being shipped for treatment are addressed under Sect. 4.1.3.

Waste Disposal. Under normal operations of the proposed action, all of the waste is proposed to be disposed off-site at existing, licensed/permitted facilities. Noise impacts related to transport of the wastes to the disposal facilities are addressed under Sect. 4.1.3.

Supporting Activities. The normal operations of supporting activities within the Paducah Site boundaries would have no impact on the noise level at the site. Operation of trucks and drum-handling machinery, such as forklifts, and physical volume reduction machines, such as chippers and crushers, would occur. However, these activities currently take place at the site; therefore, no increase in the current noise level is anticipated.

4.1.1.9 Cultural, archaeological, and Native American resources

No cultural, archaeological, or Native American resources are identified where waste storage, treatment, or supporting waste disposition activities are proposed to occur. Therefore, no impacts to these resources are anticipated from any waste disposition activity.

4.1.1.10 Air quality

Waste Storage. Emissions of criteria pollutants are the primary concern from area (nonpoint) sources such as waste packaging/sorting and storage areas. No notable emissions of criteria air pollutants are expected from the routine packaging, handling, and storage activities of existing or future generated waste at the Paducah Site. All waste streams that are repackaged or stored would be in a stable configuration, so that minimal air emissions would occur. Liquid and volatile materials would be packaged in a manner that would avoid spillage or release to the atmosphere. Proper containers for the waste would be selected to ensure that emissions to the atmosphere during storage would be minimized. In addition, inspections would be conducted on a regular basis to ensure that there are no container breaches that could cause emissions into the air.

Waste Treatment. Particulates and dust would be the primary criteria pollutants emitted during movement of waste to on-site and off-site treatment facilities. All treatment activities would be conducted at existing facilities, so there would be no impacts from construction or site disturbance. The wastes proposed for on-site treatment would be processed by technologies, such as solidification, that historically have not produced notable air emissions. High-efficiency particulate air (HEPA) filters that would be located in the building would screen out a high percentage of airborne contaminants resulting from treatment. These facility controls result in no anticipated ambient air impacts at the Paducah Site. For further discussion of potential on-site treatment accident emissions, see Sect. 4.1.4.

Wastewater treatment techniques would be used to remove contaminants from aqueous waste streams that are suitable for on-site discharge through the permitted wastewater treatment system. Minimal air emissions would be expected from the wastewater treatment system since these proposed processes are not a notable source of air pollutants.

Under the proposed action, a portion of the wastes is proposed for off-site treatment at existing, licensed, and/or permitted facilities. This would result in no anticipated impacts at the Paducah Site.

Waste Disposal. The pollutants that would be emitted by transportation vehicles during waste movement to disposal facilities include nitrogen oxides, carbon monoxide, volatile organic compounds, particulates, and fugitive road dust emissions. Impacts on air quality from the exhaust emissions of the vehicles used to transport wastes from the Paducah Site would be very small, because only a few vehicles and a small number of daily or weekly trips would be involved. Transportation would impact the ambient air quality for a small segment of the general public for only a short period of time as the waste was being transported to a treatment and/or disposal location. The roads that would be used for transportation would be paved, with the possible exception of access roads at a treatment, storage, and disposal facility; therefore, fugitive road dust emissions would be limited and temporary. Overall, air quality impacts associated with transportation activities would be small, localized, and temporary. See Sect. 4.1.3 for more detailed air quality analysis.

All wastes are proposed to be disposed off-site at existing, licensed/permitted facilities. Therefore, non-transportation related disposal impacts are not anticipated at the Paducah Site.

Supporting Activities. Air emissions associated with supporting activities would be a combination of potential impacts discussed in previous sections on waste storage and waste treatment. Refer to these sections for further information.

4.1.1.11 Socioeconomics and environmental justice

The processing and repackaging of affected wastes for shipment are expected to result in an increase of 30 full-time-equivalent jobs per year. Transportation employment would similarly create 15 or fewer full-time-equivalent jobs. An increase of 45 total jobs would represent less than a 1% change from 1997 employment in McCracken County, which does not constitute a notable impact. Because the actual employment impact is likely to be smaller and would be spread over additional counties, there would be no notable economic impact from the proposed action. Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations," requires agencies to identify and address disproportionately high and adverse human health or environmental effects that their activities may have on minority and low-income populations. For the treatments considered in this EA, populations considered are those that live within 80 km (50 miles) of the Paducah Site. However, these groups would be subject to the same negligible impacts as the general population.

Socioeconomic impacts and environmental justice issues regarding waste transport are addressed in Sect. 4.1.3.

4.1.2 On-Site Accident Analysis and Human Health Impacts

An analysis has been performed to evaluate the potential consequences and risks of accidents affecting the PCB, LLW, MLLW, and TRU wastes currently stored at the Paducah Site. For evaluation purposes, all wastes are estimated to be treated and disposed over a 10-year period. In this option, wastes may be shipped off-site for treatment and/or disposal following on-site treatment, if required.

Accidents have been postulated and the consequences and risks evaluated. The types of accidents considered included natural phenomena, process accidents such as vehicle impacts and dropped waste packages, and industrial accidents. Consequences included radiological exposure, toxic chemical exposure, and industrial hazards leading to injuries and fatalities.

The methodology, waste characterization, and a summary of the analysis of accidents affecting the alternative are discussed in the following sections. Calculations that derive the accident analysis are presented in Appendix G.

4.1.2.1 Methodology

The estimated accident consequences were based on the inventories and material characteristics of the wastes stored on the Paducah Site. Methods used to evaluate the importance of the potential adverse effects from postulated accidents are listed in Appendix G.

4.1.2.2 Waste characterization

The wastes stored on the Paducah Site consist of PCB-containing capacitors and nearly empty transformers, LLW, MLLW, and TRU waste. The packaged wastes (excluding the capacitors and transformers) include approximately 600 m^3 (21,189 ft^3) of liquids, 350 m^3 (12,360 ft^3) of solid combustible wastes, and 10,700 m^3 (377,867 ft^3) of noncombustible solid wastes.

4.1.2.3 Accident evaluation for the proposed action

In the proposed action, the wastes are stored pending on-site treatment, on-site disposal, or shipment off-site for treatment or disposal. The types of activity associated with these actions include storage of waste containers, mechanical handling of steel waste containers, and opening of waste containers under controlled conditions to allow treatment (e.g., solidification of liquids, grouting). The general approach to the analysis described in Appendix G is to postulate accidents that have the potential to breach the steel waste containers and release the contents. Once the contents are released, the accidents are postulated to suspend a fraction of the wastes in the air or surface water. The suspended wastes are then transported to individuals and populations. The dose consequences to these individuals and populations are evaluated assuming no mitigation (i.e., no evacuation or sheltering).

Five accidents were identified as having the potential to breach the waste containers:

- Evaluation-basis earthquake (EBE)
- Large aircraft impact and fire
- General aviation impact and fire
- Ground vehicle impact/mishandling
- Ground vehicle impact and fire

Accident Selection. The following accidents are postulated for evaluation:

- The earthquake scenario affects all stored containers. The EBE is a major earthquake of 0.8 gs at bedrock, or lithified rock. The earthquake scenario used to evaluate the Paducah Site facilities has a ground surface acceleration, which DOE has estimated equates to approximately 0.5-0.6 gs. An event of this caliber is judged capable of toppling stacked drums and possibly ST-90 containers. A fraction of these toppled containers is postulated to partially fail.

- The large aircraft impact accident, if it occurred, would affect a large number of containers. In addition to mechanical damage, the released fuel could ignite the combustible wastes. The likelihood, however, of a direct impact of a large aircraft into the stored wastes is extremely small and is judged not credible based on comparisons of the aircraft impact frequencies affecting the large Paducah Site buildings. Based on the extremely low likelihood of this accident and on the fact that the consequences are judged comparable to the much more likely EBE, the large aircraft accident is not considered further.

- In contrast to the large aircraft impact accident, general aviation (small aircraft) impacts are more likely. Although the number of boxes affected would be small with respect to the earthquake, the consequences might be notable if a container were affected that had high-radionuclide-concentration, combustible wastes. As shown in Table 1.1, however, the radionuclide and toxic metal concentrations in combustible wastes are negligible with respect to other constituents. The mechanical damage to other waste forms would be comparable to the more likely vehicle impact and mishandling accidents. Based on the limited source terms and the low probability of the event, general aviation impact accidents are not considered further.

- As in the case of the small aircraft impact, a ground vehicle accident could breach one or more containers and possibly initiate a fuel fire. In general, the effects of a fire are not notable for most waste packages and vehicle impacts. However, the impact and fire accident could be postulated to breach the nearly empty PCB-containing transformers. In addition, mechanical impact accidents could release a limited quantity of high-activity wastes with a higher frequency than the EBE, and they are analyzed for this reason.

Two of these accidents, large aircraft impact and general aviation impact, were ruled out as unlikely occurrence (Appendix G). As a result, three bounding accidents have been selected for the evaluation of the proposed action: an EBE, a vehicle impact/container mishandling accident, and a vehicle impact accident and fire affecting a PCB-containing transformer. Accident selection is described in detail in Appendix G.

4.1.2.4 Waste characterization and storage configuration

The physical and radiological characteristics of the four waste streams are listed in Table 1.1. The transformers and capacitors provide containment for the PCB oils within them. The listed mass is of the entire set of transformers and capacitors, including the steel containers and the contained PCB oil. Individual capacitors each contain approximately 2 gal of PCB oil. The transformers are drained but can contain up to 10% of their total capacity of PCB oil.

The waste stream volumes of packaged wastes are directly estimated quantities. The waste stream masses are based on an estimated average density of similar wastes, 1 g/cc for liquids and soft solids and 2 g/cc for all other solids. For each isotope in the waste stream, the total isotopic activity is computed as the product of the total waste stream mass and the mean isotopic activity density. This isotopic activity is then converted to an equivalent activity of uranium and summed over all isotopes in each waste stream. Similarly, the mass of each listed toxic metal is computed based on the waste stream mass and an estimated concentration of 5,000 ppm for each metal. The mass of each metal is converted to an equivalent mass of chromium for each metal and summed over each metal in the waste stream.

The transformers are large steel shells containing the PCB oil. No additional packaging is estimated. Packaged wastes would be stored in steel containers ranging from 55-gal drums to sea-land containers. Since the larger containers, however, are difficult to topple and breach, all packaged wastes are estimated conservatively to be contained in 55-gal drums and stacked two high in a square array.

Four drums are estimated to be mounted on 1.2- × 1.2-m (4- × 4-ft) pallets in double rows and stacked two containers high. To permit access to each container, a 5-m (16-ft) aisle is estimated between each double row. Assuming an approximately square array, an array of 180 × 180 m (590 × 590 ft) is required to store the estimated 56,600 drums.

Some wastes are expected to be treated on-site or shipped off-site prior to the completion of the proposed action. For purposes of this analysis, however, all wastes are estimated to be at risk of accidental release and dispersion over the entire 10-year processing period.

4.1.2.5 Analysis of the EBE accident

A detailed analysis of the EBE accident is presented in Appendix G. Following is a summary of that analysis.

In the event of a major earthquake, the horizontal ground acceleration is estimated to be capable of creating differential movement between the top and bottom box layers, resulting in drums being toppled into the aisles. It is estimated that 10% of the entire upper layer of drums (2800 boxes) topple and fail. The 10% estimate is based on an evaluation of stacked 55-gal drums during seismic events (Hand 1998).

Results of Radiological Dose Computations. Results from the Appendix G computations for the effects of radiological dose resulting from an EBE are presented in Tables 4.1 and 4.2. Two source terms were considered during the computations: the airborne source term (AST) in which radioactivity is released to, and dispersed by, the air; and the liquid source term (LST) in which radiologically contaminated liquids are released to, and dispersed by, surface water.

Table 4.1. Airborne source term risks

Receptor	Distance from area	Risk (expected fatalities)
MIW/MUW	At edge	1.5×10^{-8}
MEI	1,580 m	9.5×10^{-10}
Population	General	7.5×10^{-9}

MEI = maximally exposed individual
MIW = maximally exposed involved worker
MUW = maximally exposed uninvolved worker

Table 4.2. Liquid source term risks

Receptor	Risk (expected fatalities)
MEI	4.5×10^{-11}

MEI = maximally exposed individual

The AST has the potential for widespread dissemination of radioactivity. Therefore, four receptors were evaluated:

- the maximally exposed individual (MEI),
- the maximally exposed involved worker (MIW),
- the maximally exposed uninvolved worker (MUW), and
- the general population.

The impact of the LST would be less pervasive. Therefore, the computations considered only the MEI.

In summary, the computed risks (expected fatalities) from radiological dose resulting from an EBE accident are negligible (Tables 4.1 and 4.2).

Results of Toxic Metals Exposure Computations. Effects of exposure to toxic metals were considered. As stated in Appendix G, no toxic metals are known to be in the liquid waste streams being considered in this EA. Therefore, only the AST was considered in Appendix G. The results of the computations demonstrate that the concentration of toxic metals in the AST resulting from an EBE would be negligible compared to the most conservative benchmark for human exposure.

4.1.2.6 Analysis of the vehicle impact accident

During the proposed action, vehicles such as forklifts occasionally would be used to reposition waste containers. Impacts with drums resulting in breach are estimated to occur at a rate of one per year. Thus, it is estimated that one or more drums would be breached. For the wastes stored at the Paducah Site however, 87% of all radioactivity occurs in the single drum of ThF_4, and an additional 4% occurs in the 24 drums of TRU waste. The risks of accidents involving these wastes bound the risks of other waste streams.

The computations for analyzing the vehicle mishap/mishandling accident in Appendix G evaluated the risks (expected fatalities) resulting from rupturing the ThF_4 drum or any of the 24 drums containing TRU waste. This analysis takes into account the estimated accident frequency and the probability that the damaged drum would be either the ThF_4 drum or 1 of the 24 TRU waste drums out of a total of 56,000 drums. Other assumptions for the computations are presented in Appendix G. The results of the computations, presented in Table 4.3, show that the risk of the vehicle mishap/mishandling accident is negligible but slightly greater than for the EBE. However, it was assumed for the EBE computations that the ThF_4 drum would not be placed in a vulnerable position and would not be ruptured during the EBE. If, instead, the ThF_4 drum had been assumed to be placed in a vulnerable position for the EBE analysis, the results would have been similar to those for the vehicle mishap/mishandling computations.

Table 4.3. Vehicle impact accident risks

Contaminant	Receptor	Risk (expected fatalities)
ThF_4	MUW	7.9×10^{-8}
	MEI	1.1×10^{-9}
	Population	2.3×10^{-9}
TRU	MUW	1.7×10^{-8}
	MEI	2.4×10^{-10}
	Population	5.2×10^{-10}

MEI = maximally exposed individual
MUW = maximally exposed uninvolved worker
TRU = transuranic

4.1.2.7 Analysis of the vehicle impact/mishandling and fire accident

In addition to releases of radionuclides during a vehicle impact/mishandling accident, it is also possible that a PCB-containing transformer could be ruptured with ensuing combustion of the PCB oil. PCB combustion results in the release of several toxic substances. Essentially all of the chlorine (Aroclor 1254 is 54% chlorine) is stripped and released as hydrochloric acid (HCl). Also during combustion, approximately 1% of the PCB forms a pyrolyzed mixture of PCB, dioxins, and furans, also know as PCB soot.

Concentrations of HCl and PCB soot arising from a PCB fire were calculated in Appendix G. When compared to benchmarks (Table 4.4) neither the calculated HCl nor PCB soot occur in concentrations that would create adverse health effects to the MUW or MEI. The calculated concentration of HCl is 20% of the Emergency Response Planning Guideline—Level 2. The calculated concentration of PCB soot is 37% of the "no observed adverse effect level."

Table 4.4. Calculated concentrations of HCl and PCB soot resulting from a PCB fire compared to standard benchmarks

Substance	Calculated Concentration	Benchmark Concentration[a]
HCl	6.1 mg/m^3	30 mg/m^3
PCB soot	0.11 mg/m^3	0.3 mg/m^3 for 1 hour

[a] Benchmark for HCl is the Emergency response Planning Guideline—Level 2. For PCB soot it is the "no observed adverse affect level."

HCl = hydrochloric acid

PCB = polychlorinated biphenyl

4.1.2.8 Analysis of industrial accidents

During the proposed action, it is estimated that the wastes are stored and monitored, transported to waste treatment locations on-site, and prepared for transportation off-site. It is estimated that these activities require 60 full-time equivalents or 120,000 person-h/year over the 10-year duration. Based on the 3.4×10^{-3}/200,000 person-h industrial fatality rate, 2.0×10^{-3} fatalities/year or 2.0×10^{-2} fatalities/10 years are expected.

4.1.3 Transportation Impacts

The proposed action would include shipment of heterogeneous LLW, MLLW, and TRU waste by truck, rail, or intermodal transport. LLW may be shipped only by truck and not by rail due to regulatory limits on the inventory of radionuclides.

4.1.3.1 Air quality

The Clean Air Act of 1970, Sect. 176 (c), requires EPA to establish rules to ensure that federal agency actions conform with state implementation plans (SIPs). These plans are designated to eliminate or reduce the severity and number of violations of the National Ambient Air Quality Standards (NAAQS). As a result, EPA promulgated the "General Conformity" rule (58 FR 63214-63259) in November 1993. This rule applies in areas considered "nonattainment" or "maintenance" for any of six criteria air pollutants (ozone, carbon monoxide, sulfur dioxide, nitrogen dioxide, particulate matter, and lead). A nonattainment area is one in which the air quality in an area exceeds the allowable NAAQS for one or more pollutants, while a maintenance area is one that has been redesignated from nonattainment to attainment. The general conformity rule covers direct and indirect emissions of criteria pollutants caused by federal actions and that exceed the threshold emissions levels shown in 40 *CFR* 93.153(b). Each affected state is required by Sect. 176(c) of the 1990 Clean Air Act amendments to devise a SIP, which is designed to achieve the NAAQS.

DOE has integrated the requirements of the general conformity rule with those of its NEPA process wherein, for actions not exempted, the total emissions from the proposed action are evaluated to determine when they are above de minimus thresholds and whether they are regionally important.

Since many of the representative transport routes are duplicative of routes assessed in the EA for transport of LLW from the Oak Ridge Reservation to off-site treatment and disposal facilities (DOE 2000b), the same analysis presented previously is given here. This analysis is provided as follows:

Nonattainment areas associated with each route:

- Nevada Test Site option: Las Vegas, Nevada.
- Clive, Utah, option: St. Louis, Missouri; Kansas City, Missouri-Kansas; and Salt Lake City, Utah.
- WCS (Andrews, Texas) option: Dallas-Fort Worth, Texas, area.
- Hanford option: St. Louis, Missouri; Kansas City, Missouri-Kansas; Ogden, Utah; and Boise, Idaho.
- For transport to commercial treatment facilities near Oak Ridge, there are no nonattainment areas. The Knoxville-Oak Ridge area is in an attainment region where criteria air pollutants do not exceed standards.

Air quality impacts from highway transport

The LLW transport EA (DOE 2000b) analyzed the maximum number of truck shipments that would occur in any one year: 835. It was expected that shipments would be spread evenly over the year; thus, the maximum in any 1 week would be 16, or 2 to 3 per day. All major nonattainment areas are associated with large metropolitan areas. Planned shipments of two to three per day maximum would not discernibly increase the daily rate of truck traffic for these metropolitan areas, and they are minimal compared with the daily rate of truck traffic in the areas. The Paducah Site anticipates making only 762 shipments per year. However, the Oak Ridge EA analysis provides a conservative result using an assumption of 835 per year.

In the brief Oak Ridge EA (DOE 2000b), analysis was undertaken to determine the impact of the proposed shipments relative to the threshold emission levels in nonattainment areas described by EPA in its air conformity regulations [40 *CFR* 93.153(b)(1)]. The EPA general conformity rule (58 FR 63214, November 30, 1993) requires federal agencies to prepare a written conformity analysis and determination for proposed activities only in those cases where total emissions of an activity exceed the threshold emission levels. Where it can be demonstrated that emissions from a proposed new activity fall below the thresholds, these emissions are considered to be de minimus and require no formal analysis.

The Oak Ridge EA (DOE 2000b) proposed routes were evaluated for maximum road miles proposed to be traveled for each criteria pollutant. Carbon monoxide, ozone, and particulate matter smaller than 10 micrometers (PM_{10}) were the criteria pollutants used. The maximum road miles traveled through a nonattainment area would be approximately 150 miles (includes return trip) through the Dallas-Fort Worth, Texas, area (Atlanta and St. Louis areas are nearly as large). This distance conservatively includes a return truck trip even though the return trip is not part of the Oak Ridge proposed action (no LLW on the truck), and it is likely that commercial vehicles would not return to Oak Ridge by the same route if they were able to contract a load for the return trip.

The EPA threshold for carbon monoxide for all nonattainment and maintenance areas is 200,000 lb (100 tons)/year for any new proposed activity. The EPA threshold for ozone (measured by its precursor, NO_x for "ozone attainment areas outside an ozone transport region" such as Dallas-Fort Worth) is 200,000 lb (100 tons)/year. The EPA threshold for PM_{10} for all moderate nonattainment areas is 200,000 lb (100 tons)/year for any new proposed activity. Emission factors for carbon monoxide and ozone for various motor vehicle types have been modeled for the year 1990 (Goel 1991). Emission factors for PM_{10} have been calculated using EPA's February 1995 model for that criteria pollutant. Heavy duty diesel-powered vehicles (HDDVs) are defined as any diesel-powered motor vehicle designated primarily for the transportation of property and rated at more than 8500 lb of gross vehicle weight. For HDDVs, including the standard commercial semitractor vehicles that would be used for pulling waste shipments, the average emission for carbon monoxide is estimated as 11.03 g/mile, while the NO_x (an ozone precursor) emission rate is 22.91 g/mile. Finally, the emission factor for PM_{10} is 14.87 g/mile.

Using a maximum of 835 shipments (truck round trips)/year, the carbon monoxide emission rate was estimated for the maximum distance traveled through a nonattainment area (Dallas-Fort Worth). This emission rate was approximately 3047 lb of carbon monoxide/year. This amount of emissions is below the threshold standard of 100 tons/year and is clearly a de minimus amount. Therefore, the deduction is made that the Paducah Site's proposed action of 762 shipments per year would also be de minimus.

Using a maximum of 835 shipments/year (truck round trips), an ozone emission rate was established for the maximum distance traveled within a nonattainment area (Dallas-Fort Worth area). This emission rate was approximately 6313 lb of NO_x/year (NO_x is a precursor to ozone). This amount of emissions is below the threshold standard of 100 tons/year and clearly a de minimus amount. Therefore, the deduction is made that the Paducah Site's proposed action of 762 shipments per year would also be de minimus.

Finally, using 835 shipments/year, a PM_{10} rule was established for the maximum distance within a nonattainment area (Dallas-Fort Worth). The emission rate was 4102 lb of PM_{10}/year. This amount is below the threshold standard of 100 tons/year and is clearly a de minimus amount. Therefore, the deduction is made that the Paducah Site's proposed action of 762 shipments per year would also be de minimus.

Because the Dallas-Fort Worth area example maximizes road miles traveled through a nonattainment area and also conservatively estimates emission factors, it is assumed that this example "bounds" the impacts within other nonattainment areas for the proposed action. Therefore, air emissions within all nonattainment areas along shipment routes are well below the EPA threshold emission levels, and thus require no formal conformity analysis.

4.1.3.2 Human Risk associated with truck transportation

This section discusses potential impacts associated with transporting the LLW, MLLW, and TRU waste in the following DOT- and RCRA-compliant shipping configurations[a]:

- **LLW:** The containers used for the transportation of LLW solids and liquids and the maximum load per shipment are as follows:

  — ST-90 boxes, 4 boxes/shipment;
  — 55-gal drums, 78 drums/shipment;
  — 85-gal drums, 40 drums/shipment;

[a] 762 shipments/(52 weeks/year) = 15 shipments/week. This makes the conservative assumption that each shipment takes 1 week to make a round-trip, so each shipment in a week requires a separate driver, and all shipments are made within a year. Actual shipment round-trips are likely to be shorter, reducing the number of drivers required. The number of shipments was taken from the waste stream table.

— B-25 boxes, 4 boxes/shipment; and
— tanker trucks.

- **MLLW:** The containers used for transportation of MLLW solids and liquids and the maximum load per shipment are as follows:

  — 55-gal drums, 78 drums/shipment;
  — 85-gal drums, 40 drums/shipment;
  — B-12 boxes, 4 boxes/shipment; and
  — tanker trucks.

- **TRU Waste:** The container used for transportation of TRU waste is 55-gal drums in one truck shipment. These drums will be overpacked in TRUPAC II or HALFPAC containers to met applicable protocols.

Radiological Impacts from normal Truck Transportation. The potential effects of transporting waste by highway from Paducah to each of the potential final destination sites described in Sect. 3.10 were evaluated for all three waste subgroups on an annual basis during the major shipment year groupings and on a total 10-year shipping campaign basis.

The potential radiological effects of routinely transporting waste by highway from Paducah to each of the potential final destination sites described in Sect. 3.10 were estimated for all three waste subgroups on an annual basis during the major shipment year groupings, and on a total 10-year shipping campaign basis. Details of the evaluation are presented in Appendix H. Truck shipments to Andrews, Texas, Richland Washington, Mercury, Nevada, Clive, Utah, Oak Ridge [East Tennessee Technology Park (ETTP)], Tennessee, Oak Ridge (ORNL), Tennessee, and Oak Ridge Materials & Energy/Waste Control Specialists (MEWC), Tennessee, were evaluated for the probability of an latent cancer fatality (LCF) to the truck crew, the general population, and the MEI. The results of the evaluation are summarized below in Table 4.5, which shows the worst-case results from the seven evaluated truck routes. It turns out that the worst-case results for the truck crew, general population, and MEI all occur during the shipment to Mercury, Nevada.

Table 4.5. Worst-case radiological impacts for truck shipments (to Mercury, NV)

Risk group	Annual impacts		Total for 10-year life cycle	
	Dose (person-rem)[a]	LCF	Dose (person-rem)	LCF
Crew	6.1	2.4×10^{-3}	61	2.4×10^{-2}
Population[b]	2.4	1.2×10^{-3}	24	1.2×10^{-2}
MEI[c] (rem)	3.4	1.7×10^{-3}	3.4×10^{-4}	1.7×10^{-7}

[a]Person-rem represents the collective dose received by a group of workers or members of the public.
[b]Includes population dose receptors off-link and on-link.
[c]MEI latent cancer fatality represents the probability of a latent cancer fatality occurrence.
LCF = latent cancer fatality
MEI = maximally exposed individual

The estimated risks to the public are proportional to the total number of people potentially exposed to radiation while shipments are in transit. This potentially exposed population is estimated from population density categories and the distance traveled, as described in Sect. 3.10.1. The estimated risks to the public are based on a total dose across all persons within the potentially exposed population. The differences in estimated risks to the public between destinations are due to differences in the total number of potentially exposed people and do not reflect risks to an individual due to higher dose estimates.

The estimated risks to workers differ between destinations due to the distance of the destination from Paducah and to the radiological characteristics of the waste forms being transported. The estimated risks from radiation exposure for the trucking crew would be directly proportional to the number of miles traveled, the type of waste, and the number of shipments that were used to estimate the risks for each destination.

The MEI dose estimates demonstrate the relatively small dose a single individual is likely to receive. The MEI dose estimates are also considered extremely conservative, since this individual is a hypothetical member of the public who lives 30 m (98 ft) from the highway and would be exposed to every shipment of waste. Differences between the estimated risks to the MEI between waste subgroups were due to the differences in number of shipments between subgroups and to the differences in risk from the subgroup wastes themselves.

Cargo-Related Radiological Impacts During a Highway Accident. The probability of a highway accident occurring during waste transportation by truck was evaluated for each of the seven receiving locations. In addition, the radiological dose resulting from these accidents was calculated and the risk of LCFs to the general public were also calculated. The details of this analysis are presented in Appendix H, and the results are summarized below in Table 4.6. As summarized in Table 4.6, the worst-case calculated number is far less than 1 LCF (1.5×10^{-3}) for shipment to Mercury, Nevada. For the entire waste transportation campaign, the calculated value is still less than 1 latent cancer fatality (2.5×10^{-3}).

Table 4.6. Cargo-related impacts resulting from truck transportation accidents

	Population risk[a]	
Destination	**Dose (person-rem)**	**Latent cancer fatalities**
Andrews, TX	0.07	3.5×10^{-5}
Hanford, WA	1.55	7.8×10^{-4}
Clive, UT	0.09	4.5×10^{-5}
Mercury, NV	3.0	1.5×10^{-3}
Oak Ridge (ETTP), TN	.02	1.0×10^{-5}
Oak Ridge (ORNL), TN	0.18	9.0×10^{-5}
Oak Ridge (MEWC) TN	0.02	1.0×10^{-5}
Total	**4.9**	$\mathbf{2.5 \times 10^{-3}}$

[a]Each population risk value is the product of the consequence (population dose or latent cancer fatalities) multiplied by the probability for a range of possible accidents.

ETTP = East Tennessee Technology Park
MEWC = Materials & Energy/Waste Control Specialists
ORNL = Oak Ridge National Laboratory

Vehicle-Related Impacts. Potential vehicle-related impacts, including expected accidents, expected fatalities from accidents, and impacts from vehicle emissions were evaluated in Appendix H. The results of the evaluation are summarized in Table 4.7. Impacts from vehicle-related accidents and emissions are highest for the Mercury (Nevada Test Site), Nevada, and Clive (Envirocare), Utah, destinations because of the larger number of shipments and the total miles traveled to and from these destinations. However, vehicle-related impacts for these locations are calculated to be minimal.

Table 4.7. Estimated fatalities from truck emissions and accidents (vehicle-related impacts)

Destination[a]	Incidents		Latent fatalities from emissions[b]
	Accidents	Fatalities	
Andrews, TX	6.0×10^{-2}	3.1×10^{-3}	1.3×10^{-2}
Hanford, WA	9.0×10^{-3}	3.8×10^{-4}	2.1×10^{-3}
Clive, UT	7.3×10^{-1}	2.7×10^{-2}	1.6×10^{-1}
Mercury, NV	1.1	4.1×10^{-2}	2.6×10^{-1}
Oak Ridge (ETTP), TN	1.2×10^{-2}	6.8×10^{-4}	4.2×10^{-3}
Oak Ridge (ORNL), TN	5.4×10^{-4}	3.2×10^{-5}	2.0×10^{-4}
Oak Ridge (MEWC), TN	2.5×10^{-3}	1.4×10^{-4}	8.8×10^{-4}
TOTAL	**1.89**	**0.08**	**0.43**

[a]Accidents and fatalities are based on round-trip distance traveled.
[b]Calculated for travel through urban areas only.
ETTP = East Tennessee Technology Park
MEWC = Materials & Energy/Waste Control Specialists
ORNL = Oak Ridge National Laboratory

4.1.3.3 Human Risk associated with rail transportation

Radiological Impacts from normal Rail Transportation. The potential radiological effects of routinely transporting LLW, MLLW, and TRU waste by rail from Paducah to each of the potential final destination sites described in Sect. 3.10 were estimated for all three waste subgroups on an annual basis during the major shipment year groupings and on a total 10-year shipping campaign basis. Details of the evaluation are presented in Appendix H. Rail shipments to Hobbs, New Mexico, Hanford, Washington, Clive, Utah, Mercury Nevada, Oak Ridge (ETTP), Tennessee, Oak Ridge (ORNL), Tennessee, and Oak Ridge (MEWC), Tennessee, were evaluated for the probability of an LCF to the train crew, the general population, and the MEI. The results of the evaluation are summarized below in Table 4.8, which shows the worst-case results from the seven evaluated train routes. It turns out that the worst-case results for truck crew, general population, and MEI all occur during the shipment to Mercury, Nevada.

Table 4.8. Worst-case radiological impacts for rail shipments (to Mercury, Nevada)

Risk group	Annual impacts		Total for 10-year life cycle	
	Dose (person-rem)[a]	LCF	Dose (person-rem)	LCF
Crew	2.7	1.1×10^{-3}	27	1.1×10^{-2}
Population[b]	8.1	4.1×10^{-3}	81	4.1×10^{-2}
MEI[c] (rem)	7.3×10^{-5}	3.7×10^{-8}	7.3×10^{-4}	3.7×10^{-7}

[a]Person-rem represents the collective dose received by a group of workers or members of the public.
[b]Includes population dose receptors off-link and on-link.
[c]MEI LCF represents the probability of an LCF occurrence.
LCF = latent cancer fatality
MEI = maximally exposed individual

As with truck transportation, the estimated risks to the public are proportional to the total number of people potentially exposed to radiation while shipments are in transit. This potentially exposed population is estimated from population density categories and the distance traveled, as described in Sect. 3.10.1. The estimated risks to the public are based on a total dose across all persons within the potentially exposed population. The differences in estimated risks to the public between destinations are due to differences in the total number of potentially exposed people and do not reflect risks to an individual due to higher dose estimates.

The estimated risks to workers differ between destinations due to the distance of the destination from Paducah and to the radiological characteristics of the waste forms being transported. The estimated risks from radiation exposure for the rail crew would be directly proportional to the number of miles traveled, the type of waste, and the number of shipments that were used to estimate the risks for each destination.

The MEI dose estimates demonstrate the relatively small dose a single individual is likely to receive. The MEI dose estimates are also considered extremely conservative, since this individual is a hypothetical member of the public who lives 30 m (98 ft) from the railway and would be exposed to every shipment of waste. Differences between the estimated risks to the MEI between waste subgroups were due to the differences in number of shipments between subgroups and to the differences in risk from the subgroup wastes themselves.

Maximally Exposed Individual. The MEI dose estimates presented in Appendix H demonstrate the relatively low dose a single individual is likely to receive. The MEI dose estimates are also considered extremely conservative, since this individual is a hypothetical member of the public who lives 30 m (98 ft) from the railway and would be exposed to every shipment of waste.

Differences between the estimated risks to the MEI between waste subgroups were due to the differences in the number of shipments between subgroups and to the differences in risk from the subgroup waste itself. For example, the 10-year analysis period for shipment of waste to Oak Ridge (ORNL), Tennessee, results in an MEI dose of 4.4×10^{-6} rem. The MEI dose to the Las Vegas, Nevada destination for the 10-year period is 7.3×10^{-4}, and the resultant probability of an LCF is minimal at 3.7×10^{-7}.

Cargo-Related Radiological Impacts During a Rail Accident. The probability of a railroad accident occurring during waste transportation was evaluated for each of the seven receiving locations. In addition, the radiological dose resulting from these accidents was calculated and the risk of LCFs to the general public were also calculated. The details of this analysis are presented in Appendix H, and the results are summarized below in Table 4.9. As summarized in Table 4.9, the worst-case calculated number is far less than 1 latent cancer fatality (1.6×10^{-3}) for shipment to Mercury, Nevada. For the entire waste transportation campaign, the calculated value is still less than 1 LCF (2.8×10^{-3}). Calculated population risk for rail transportation is equivalent to that for transportation by truck (Table 4.6).

Table 4.9. Cargo-related impacts from rail transportation accidents

	Population risk[a]	
Destination	Dose (person-rem)	LCF
Hobbs, NM	0.07	3.5×10^{-5}
Hanford, WA	1.74	8.7×10^{-4}
Clive, UT	0.07	3.5×10^{-5}
Las Vegas, NV	3.2	1.6×10^{-3}
Oak Ridge (ETTP), TN	0.09	4.5×10^{-5}
Oak Ridge (ORNL), TN	0.4	2.0×10^{-4}
Oak Ridge (MEWC), TN	4.4×10^{-2}	2.2×10^{-5}
Total	**5.51**	$\mathbf{2.8 \times 10^{-3}}$

[a]Each population risk value is the product of the consequence (population dose or LCF) multiplied by the probability for a range of possible accidents.

ETTP = East Tennessee Technology Park
LCF = latent cancer fatality
MEWC = Materials & Energy/Waste Control Specialists
ORNL = Oak Ridge National Laboratory

Rail-Related Impacts. Potential rail-related impacts, including expected accidents, expected fatalities from accidents, and impacts from vehicle emissions were evaluated in Appendix H. The results of the evaluation are summarized in Table 4.10. Impacts from rail-related accidents and emissions are highest for the Mercury (Nevada Test Site), Nevada, and Clive (Envirocare), Utah, destinations because of the larger number of shipments and the total miles traveled to and from these destinations. However, all calculated values are much less than 1, indicating negligible impacts from rail-related accidents.

Table 4.10. Estimated fatalities from rail-related accidents

	Incidence	
Destination[a]	Accidents	Fatalities
Hobbs, NM	4.2×10^{-3}	6.9×10^{-4}
Hanford, WA	9.8×10^{-4}	3.0×10^{-4}
Clive, UT	2.6×10^{-2}	8.6×10^{-3}
Las Vegas, NV	5.1×10^{-2}	1.5×10^{-2}
Oak Ridge (ETTP), TN	1.2×10^{-3}	2.8×10^{-4}
Oak Ridge (ORNL), TN	1.0×10^{-4}	2.3×10^{-5}
Oak Ridge (MEWC), TN	2.5×10^{-4}	5.7×10^{-5}
Total	**0.08**	**0.02**

[a]Accidents and fatalities are based on round-trip distance traveled.
ETTP = East Tennessee Technology Park
MEWC = Materials & Energy/Waste Control Specialists
ORNL = Oak Ridge National Laboratory

4.1.3.4 Socioeconomics and environmental justice

The processing and repackaging of affected wastes for shipment are expected to result in an increase of 30 full-time-equivalent jobs per year. Transportation employment would similarly create 15 or fewer full-time-equivalent jobs[a]. An increase of 45 total jobs would represent less than a 1% change from 1997 employment in McCracken County, which does not constitute a notable impact. Because the actual employment impact is likely to be smaller and would be spread over additional counties, there would be no notable economic impact from the proposed action.

Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations," requires agencies to identify and address disproportionately high and adverse human health or environmental effects that their activities may have on minority and low-income populations. For the treatments considered in this EA, populations considered are those that live within 80 km (50 miles) of the Paducah Site. For transportation alternatives, populations considered are those that live along the highways or rail lines where transport of packaged waste would occur (as described in Sect. 3.10) and people using the highways and/or stopping at rest stops. Individual access and use of public highways or rest stops that would be used by trucks shipping waste are not limited or restricted to any particular population group, economically disadvantaged or advantaged. Because it is expected that the percentage of minority or low-income households within the potentially exposed population would vary along the highway routes used for the proposed action, no disproportionate effects to those minority or low-income households located along the routes can be identified. These groups would be subject to the same negligible impacts as the general population.

[a] 762 shipments/(52 weeks/year) = 15 shipments/week. This makes the conservative assumption that each shipment takes 1 week to make a round-trip, so each shipment in a week requires a separate driver, and all shipments are made within a year. Actual shipment round-trips are likely to be shorter, reducing the number of drivers required. The number of shipments was taken from the waste stream table.

Most of the risk associated with incident-free transportation of waste by highway is the exposure of the public to radiation at rest stops, followed by exposure of truck crews. These exposures are put into perspective by comparison to a hypothetical MEI dose estimate (i.e., an individual who would be exposed to each shipment of waste). As discussed in Sect. 4.1.2, the MEI estimate is small compared to estimates of expected exposures from background radiation. The estimated risks of cancer resulting from vehicle emissions contributed by the waste transportation program are also anticipated to be low. Estimated risks resulting from transportation by rail are as low or lower than from highway transportation.

4.1.3.5 Natural Resource Impact

Accidents from truck and/or rail transport of wastes have the potential to impact national resources. Impacts could result from accidents that result in a waste container breach, leading to a waste spill. The introduction of contaminants into any natural resources (i.e., water, soils, wetlands, etc.) would result in short-term impacts to the receiving resource. The impacts are estimated to be short term due to cleanup efforts that would follow a spill. Impacts are also determined to be minor due to the utilization of mitigative measures exercised during waste transport. These measures, such as proper waste containerization and packaging, would decrease the amount of contamination spilled.

4.1.4 On-site Treatment Impacts

The following sections present potential impacts resulting from on-site treatment of a subset of the total waste volume on the Paducah Site.

4.1.4.1 Air Quality

Normal operation of the Waste Treatment Facility would not result in adverse impacts to the environment or to the health and safety of the public or workers. Normal airborne emissions of chemicals from the treatment processes would be treated to reduce concentrations to below permissible Clean Air Act environmental and worker exposure limits by HEPA filters before discharge from the facility enclosure, and subsequently, from Building C-752A. Workers inside the Treatment Facility would be protected from adverse effects of normal emissions of chemicals by the appropriate level of personal protective equipment (PPE). Solid (non-radioactive) wastes resulting from the Treatment Facility normal operation would be treated and/or packaged for subsequent offsite disposal, in accordance with Site Waste Management procedures, to preclude adverse impacts to the environment or public/worker health and safety.

The likelihood of accidents that may affect air quality are low due to the implementation of mitigative measures such as filters, process controls, and the proper training of treatment facility personnel. However, the airborne environmental consequence of an instantaneous release of nitric acid is evaluated in Appendix I. The evaluation shows a release of 500 gal of nitric acid would be in the form of a dispersion distance of 6.1 km (3.8 miles) to the Toxic Endpoint ["immediately dangerous to life or health" (IDLH) limit]. If the effect of the treatment facility enclosure is included in this scenario, the dispersion distance is reduced to 0.8 km (0.5 mile), which is within the nearest DOE property line. The unmitigated airborne environmental consequence of a small leak from the nitric acid storage container is a dispersion distance of 0.3 km (0.2 mile) to the Toxic Endpoint limit. The respirable impact of the alternative-case scenario on workers in the treatment facility wearing the minimum required level of personal protective equipment is an exposure to toxic chemicals at levels slightly above the IDLH limits. A release of airborne contamination from the rupture of a calcium hydroxide bag would produce lower consequences to potentially exposed workers.

4.1.4.2 Radiological consequences for on-site treatment of waste

Detailed analysis of radiological impacts to the public and to workers resulting from on-site treatment of LLW and TRU waste is contained in Appendix J. Table 4.11 summarizes the results by listing the projected health impacts to the public from routine operations of the on-site treatment facility.

The table indicates that impacts are not notable for the entire treatment process or for individual waste stream groups. The values in this table are conservative, since the dose calculations were based on atmospheric suspension of the entire radioactive quantities of each waste stream inside the treatment facility. This waste quantity was then estimated to be released to the environment via the facility high-efficiency particulate air filtration system that typically removes 99.999% of the radioactive contaminants. Actual dose from normal operations should be considerably less, since only a small fraction of the radioactive materials would become airborne during normal operations.

Table 4.11. Impacts on public health from normal operations of on-site treatment facility[a]

Waste group	Total dose: MEI[b] (mrem)	Total dose: Population (person-rem)	Population LCF[c]
Lab waste (439)	3.10×10^{-7}	2.92×10^{-4}	1.46×10^{-8}
Tc-99-contaminated waste (2802)	1.17×10^{-3}	3.28	1.64×10^{-4}
TRU waste—solids (444)	1.50×10^{-3}	1.42	7.11×10^{-5}
TRU waste—liquids (444)	2.48×10^{-3}	2.47	1.24×10^{-4}
Total	5.15×10^{-3}	7.17	3.59×10^{-4}

[a]Impacts are based on radioactive quantities for the waste streams listed here and identified in Table 1.1.
[b]MEI = Maximally exposed individual calculated to be approximately 1500 meters north of facility.
[c]LCF = Estimated number of latent cancer fatalities within the public from on-site treatment of projected waste quantities.
TRU = transuranic.

The results for the analysis of the impact to workers from an on-site treatment facility are summarized in Table 4.12. The table shows that the number of fatalities is calculated to be much less than one over the 3 to 4 months estimated to complete the on-site treatment.

Table 4.12. Impacts on workers from normal operations of on-site treatment facility

Workers	Impacts from operations
Average radiological dose to worker (rem)[a]	0.023
Total projected radiological dose to all rad workers (person-rem)[b]	0.34
Estimated number of latent cancer fatalities from total worker dose	1.4×10^{-4}

[a]Estimate of average dose to workers is based on the DOE average annual measurable total effective dose equivalent (TEDE = sum of internal and external dose) for waste processing/management facilities during 1997–1999 (DOE 2000c).
[b]Total projected worker dose calculated for an estimated 15 maximum radiological workers within the facility.
DOE = U.S. Department of Energy

The total radiation dose to the MEI of the general public for all Paducah Site operations has been estimated at 1 mrem/year (DOE 1999a), which is 1% of the radiation dose limit (100 mrem/year) set for the general public for operation of a DOE facility (DOE Order 5400.5). The external radiation dose for Paducah Site workers has ranged from 0 to 11 mrem/year in recent years (DOE 1999a). These doses are well below both the DOE administrative procedures dose limit (2000 mrem/year) and the regulatory limit of 5000 mrem/year (DOE 1999a; 10 *CFR* 835). The EPA limit is 15 mrem/year for an individual member of the public from all sources. All of these exposures are a very small fraction of the 360 mrem/year dose received by the general public and by workers from natural background and medical sources.

4.1.4.3 Socioeconomics and environmental justice

No census tracts near the site include a higher proportion of minorities than the national average. Some nearby tracts meet the definition of low-income populations, including two tracts in the north-northeast direction of the prevailing wind, but these are not the tracts closest to the Paducah Site. Impacts from noise, air emissions, radiological emissions, and accidents associated with waste treatment would be low for both the residents closest to the site and the low-income communities. Exposures for the general public and the workers affected in processing and repackaging are expected to be similar to historical exposures for Paducah Site operations overall.

Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations," requires agencies to identify and address disproportionately high and adverse human health or environmental effects that their activities may have on minority and low-income populations. For the activities considered in this EA, populations considered are those that live within 80 km (50 mi) of the Paducah Site. However, these groups would be subject to the same negligible impacts as the general population.

4.1.5 DMSA Characterization

The following sections present potential impacts resulting from on-site characterization for DMSA wastes. Any potential impacts associated with postcharacterized DMSA waste transport or treatment are addressed in Sects. 4.1.3 and 4.1.4, respectively.

4.1.5.1 Impacts to the public from DMSA waste characterization normal operations

The DMSA waste comprises a large portion of the LLW and mixed waste quantities being considered in this EA. However, current quantities have not resulted in adverse impacts to the public and environment within the Paducah Site surrounding areas. The public access areas and the 50-mile radius surrounding the Paducah Site is monitored for radioactive emissions, and estimated doses to the public are reported in the Paducah Site Annual Environmental Report. DOE would continue to monitor impacts to the public and take appropriate actions to keep doses at minimal levels. Based on historical data, there have been no emissions or releases of DMSA wastes that have posed a hazard to the public or environment. However, as stated earlier, DOE has placed a high priority to characterize and dispose of DMSA waste on a previously agreed-upon schedule with state regulators.

4.1.5.2 Accident analysis for impacts from DMSA waste characterization activities

The DMSA solids and liquids at the Paducah Site contain radiological as well as chemical hazards. The relatively large quantities of DMSA waste contain alpha, beta, and gamma-emitting radionuclides. This results in a potential to contribute important doses to workers if the waste is handled improperly. However, since the waste is stored in administratively controlled areas in approximately 160 locations, it is assumed that the entire contents would not be subject to likely accident scenarios. The DMSA waste would be found in well-defined limited quantities when undergoing characterization activities. The inspector would be fully trained and qualified to characterize DMSA waste, thereby minimizing the impacts from accident consequences.

Accident scenarios analyzed in previous sections include DMSA waste quantities. Refer to Sect. 4.1.3 for further discussion.

A portion of the DMSA waste may be located in non-RCRA/TSCA storage locations pending confirmation of type of waste. These wastes could result in health and safety impacts if they are not handled properly. Accidental releases to the environment via the atmospheric pathway or releases into effluent streams from DMSA solids and liquids could also result in minor impacts to the public and the environment. In order to minimize these accident-related impacts to workers, the public, and the environment, DOE has placed DMSA waste on a high priority for characterization, treatment, and disposal activities.

4.2 IMPACTS OF THE NO ACTION ALTERNATIVE

Under the No Action alternative, not only would current wastes not be removed from the site, but newly generated waste would be continually added to the current inventory. The probability of impacts would increase over time as volumes of waste increase and new storage facilities are constructed. The No Action alternative would also have ramifications related to regulatory noncompliance.

The No Action alternative is evaluated in detail in Appendix K. Following is a summary of the conclusions of Appendix K.

4.2.1 Resource Impacts

Under the No Action alternative, on-site storage of existing and newly generated waste would continue. No treatment or disposal activities would occur after expiration of existing CXs. The following sections discuss impacts resulting from the No Action alternative.

4.2.1.1 Land use

The No Action alternative would not affect land use classifications. However, new storage buildings would be required to store waste generated from ongoing operations through 2010 and beyond. NEPA analysis for new buildings would be performed as needed.

4.2.1.2 Geology

The No Action alternative would not affect site geology.

4.2.1.3 Soils and prime farmland

Prime farmland would not be affected.

4.2.1.4 Water and water quality

Evaluation of water and water quality in Appendix K shows that short-term and long-term impacts to surface water from the No Action alternative should be similar to those currently occurring from activities at the Paducah Site. This interpretation is based on the fact that the quality of water being discharged from the plant is not degrading.

Accident impacts to water quality from the worst-case on-site accident scenario (i.e., earthquake) involving radionuclides are the same as for the proposed action and are described in detail in Appendix C. Just as for the proposed action, calculations for the earthquake scenario show that there is likely to be harm done to water quality in creeks draining into the Ohio River as a result of exposure to radionuclides, but the Ohio River water quality should not be adversely impacted.

4.2.1.5 Ecological resources

The No Action alternative would not adversely affect any threatened or endangered species.

Aquatic Biota. Short- and long-term impacts to aquatic biota from the No Action alternative would be similar to those currently occurring from the Paducah Site activities. While there is some current evidence for toxicity to aquatic biota at one outfall (Appendix K), a plan for a toxicity reduction evaluation (TRE) has been submitted to state regulators for approval. The successful completion of the TRE should eliminate further toxicity.

Bioaccumulation studies for PCBs and mercury in fish show that concentrations are decreasing, which means that controls and remediation of sources have been effective. However, there is evidence of degradation in fish communities downstream of discharges from the Paducah Site, probably owing to high temperatures in the effluent or increases in sedimentation (Appendix K).

Accident impacts to aquatic biota from the worst-case accident scenario (i.e., earthquake) involving radionuclides are described in detail in Appendix C for the proposed action, and the impacts should be no different for the No Action alternative. Because of this, the earthquake scenario is highly unlikely to cause harm to aquatic biota in the Ohio River as a result of exposure to radionuclides. However, just as with the proposed action, aquatic receptors in Bayou and Little Bayou creeks and other water conveyances by which the waste would reach the Ohio River would likely be affected by the caustic nature of the waste. Radiation exposure would be of an acute nature.

Accident impacts to aquatic biota from the worst-case accident scenario (i.e., earthquake) involving nonradionuclides are also described in Appendix C for the proposed action. Again, the impacts should be no different for the No Action Alternative. PCBs could pose adverse impacts to aquatic biota in the Ohio River, as well as in Bayou and Little Bayou creeks. None of the other nonradionuclide contaminants would reach high enough concentrations in the Ohio River to pose adverse impacts to aquatic biota, according to the assumptions of the accident analysis.

Terrestrial Biota. Short- and long-term impacts to terrestrial biota from the No Action alternative should be similar to those currently occurring from the Paducah Site activities. Currently, there is some indication of impacts to terrestrial biota (Appendix K), deer and raccoon in particular, although the impacts appear to be minor and the ultimate causes and effects uncertain.

Impacts to terrestrial biota from the modeled worst-case spill accident scenario (i.e., earthquake) are the same as for the proposed action and are described in Appendix C. Just as for the proposed action, long-term radiation effects to soil biota as the result of an earthquake would be negligible under the No Action alternative.

Accident impacts to terrestrial biota from the worst-case accident scenario (i.e., earthquake) involving nonradionuclides under the proposed action are described in Appendix C. The impacts to terrestrial biota under the No Action alternative should be the same. As a result, nonradionuclides would likely pose adverse impacts to soil biota if the worst-case spill accident occurred under the No Action alternative.

4.2.1.6 Noise

Noise levels would be similar to those currently at the site.

4.2.1.7 Cultural and archaeological resources

The No Action alternative is not expected to adversely impact any known cultural or archaeological resources.

4.2.1.8 Air quality

The No Action alternative would result in the continuation of current DOE waste management activities. Under the No Action alternative, potential impacts resulting from on-site treatment, transport, and disposal would not apply. Other potential impacts are presented in Sect. 4.1.1 and would be identical to the proposed action.

4.2.1.9 Socioeconomics and environmental justice

Socioeconomic Impacts. The No Action alternative would result in no net change in employment and therefore would have no notable socioeconomic impact on the ROI.

Environmental Justice. Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations," requires agencies to identify and address disproportionately high and adverse human health or environmental effects its activities may have on minority and low-income populations. For the No Action alternative considered in this EA, populations considered are those that live within 80 km (50 miles) of the Paducah Site.

Impacts from noise, air emissions, radiological emissions, and accidents would be low for both the residents closest to the site and the low-income communities. Exposures for the general public and the relevant workers would continue at historical levels for the Paducah Site (Appendix K).

4.2.2 Radiological and Nonradiological Impacts

The No Action alternative would result in continued storage of LLW and TRU waste but would not address the long-term need for a final disposal plan. Potential impacts to the workers, public, and environmental resources are presented in this section.

4.2.2.1 Potential exposure of workers to radiological emissions

As described in Appendix K, worker doses under the No Action alternative would result in less than 1 LCF per waste type based on a worker population of 30 full-time employees. The estimated radiological doses are highly conservative because the calculations assumed that workers would spend the entire workday in the waste storage areas, which is not likely. The estimate presents an upper bounding level that is unlikely to be approached due to the "as low as reasonably achievable" approach practiced at the Paducah Site. Steps taken to keep worker exposures as low as possible include limiting the time employees spend in each storage area, monitoring all worker exposure to avoid exceeding established control limits, prohibiting storage of liquids in outdoor storage areas, ensuring proper maintenance of emergency equipment, and undertaking waste minimization efforts. However, if waste quantities increase beyond current foreseeable projections, then the subsequent radiological impacts would increase incrementally on a cumulative population basis.

4.2.2.2 Potential exposure of the public to radiological emissions

The potential for public exposure to radiological emissions resulting from LLW and TRU waste management activities under the No Action alternative is limited at the Paducah Site. Radiation is minimized by time, distance, and shielding. Therefore it is unlikely that routine waste management activities would result in measurable quantities of radiation at the Paducah Site boundaries. A perimeter-monitoring program and warning system are in place around the Paducah Site boundaries and elsewhere to evaluate impacts from routine operations as well as emergency conditions. There are off-site regulatory limits that are adhered to by the Paducah Site as well. Environmental monitoring activities are conducted routinely and reported in the Annual Environmental Monitoring Report (DOE 1999a). This report has not indicated any adverse impact from the Paducah Site operations that include waste management activities. Therefore, it is unlikely that the No Action alternative would impact the public above current levels in terms of radiological impacts from continued storage of LLW and TRU waste.

4.2.2.3 Nonradiological risks to workers from the No Action alternative

Continued storage of LLW and TRU waste at the Paducah Site under the No Action alternative would increase safety risks to workers by requiring additional handling of the waste as maintenance and repackaging activities are needed. In addition, there would be routine monitoring activities in the storage locations that can present typical safety risks. These risks have been evaluated based on the average industrial accident rates for operations at similar industries. The estimated number of total recordable cases for the 30 workers associated with the No Action alternative would be 0.78 cases per year. The estimated lost workdays (LWDs) due to occupational illness or injury would be approximately 11 per year under the No Action alternative.

In addition, as waste inventories grow over time, additional storage facilities or expansion of current capacity would be needed. This would require the use of heavy equipment and would introduce accident risks during facility construction.

4.2.3 Accident Analysis

During the No Action alternative, the packaged waste containers would be transported to an on-site location and stored. The containers would be inspected periodically to verify that the containers are intact and repaired if required. These containers would be subject to the same conditions as the stored containers in the proposed action. They would, however, be at risk for a longer period of time.

The transformers are estimated to remain in place within the process buildings and not be subject to the risks of vehicle impacts and fires. In the event of an accident, the combustion products of fires would be contained to the buildings, thus minimizing on-site and off-site consequences. Similar to the proposed action, accidents are postulated with the potential to breech the steel containers of the stored wastes and release the contents. The waste characteristics and the accident consequence methodology are the same as discussed for the proposed action in Appendix G.

The EBE and vehicle impact/mishandling accidents were evaluated for the No Action alternative. Because the waste characteristics and the accident scenarios are the same as those evaluated for the proposed alternative, the accident consequences are identical to those computed and discussed in Sect. 4.1.1. However, while the frequency of the earthquake accident is the same for both alternatives, the frequency of vehicle impact/mishandling accidents is much lower due to the lower activity level. Based on the revised accident frequencies under the No Action alternative, expected fatalities are less than under the proposed action. However, because the institutional control period is assumed to be 100 years under the No Action alternative and is only 10 years under the proposed action, fatalities from the EBE increase by a factor of 10 under the No Action alternative. However, in both cases, the calculated number of expected fatalities remains negligible under the No Action alternative.

4.2.4 Comparison of Accident Risks

As discussed in Sects. 4.1 and 4.2, risks have been computed for both process accidents and industrial accidents for the proposed action and the No Action alternatives. The highest radiological accident risk was 1.5×10^{-7} expected fatalities for the MIW/MUW at the edge of the waste storage area during and following an earthquake. This risk was computed for the 100-year no-action institutional period. The second highest risk, 7.9×10^{-8} expected fatalities, was computed for the vehicle impact/mishandling accident impacting the ThF_4 container during the 10-year proposed action operating period. The risks are the same for both alternatives, but the proposed action has a shorter duration. These risks are minor.

The industrial accident risks, while higher than the radiological accident risks, were small. The computed risk for the proposed action was 0.02 expected fatalities over the 10-year operating period. The corresponding industrial accident risk for the No Action alternative was 0.1 expected fatalities over the 100-year institutional control period. Neither the risks nor the differences between them are considered notable.

4.2.5 Transportation Impacts

Under this alternative, no Paducah Site waste would be transported off-site after expiration of current CXS. Therefore, there are no transportation impacts associated with this alternative.

4.2.6 On-Site Treatment Impacts

Under this alternative no on-site treatment would occur. All wastes would be maintained in storage facilities. Therefore, no treatment impacts are associated with this alternative.

4.3 IMPACTS OF THE ENHANCED STORAGE ALTERNATIVE

Under the Enhanced Storage alternative, current wastes will remain at the site and would be stored in new or upgraded buildings designed to withstand the EBE. Newly generated waste would be continually added to the current inventory. The probability of impacts would increase slightly beyond those expected for the No Action alterative as volumes of waste increase and new/upgraded storage facilities are constructed. The Enhanced Storage alternative would also have ramifications related to regulatory noncompliance.

The Enhanced Storage alternative is a variation of the No Action alternative that is evaluated in detail in Appendix K. Following is qualitative evaluation of the Enhanced Storage alternative based on the conclusions in Appendix K.

4.3.1 Resource Impacts

Under the Enhanced Storage alternative, on-site storage of existing and newly generated waste would continue. No treatment or disposal activities would occur after expiration of existing CXs under which limited treatment and disposal are currently being performed. The following sections discuss impacts resulting from the Enhanced Storage alternative.

4.3.1.1 Land use

The Enhanced Storage alternative would not affect land use classifications. However, new/upgraded storage buildings would be required to store waste generated from ongoing operations through 2010 and beyond. NEPA analysis for new/upgraded buildings would be performed as needed.

4.3.1.2 Geology

The Enhanced Storage alternative would not affect site geology.

4.3.1.3 Soils and prime farmland

Prime farmland would not be affected.

4.3.1.4 Water and water quality

Evaluation of water and water quality in Appendix K shows that short-term and long-term impacts to surface water from the No Action alternative should be similar to those currently occurring from activities at the Paducah Site. The Enhanced Storage alternative would not result in any additional short-term or long-term surface water impacts. This interpretation is based on the fact that the quality of water being discharged from the plant is not degrading.

Accident impacts to water quality from the worst-case on-site accident scenario (i.e., earthquake) involving radionuclides are likely to be less than those evaluated for the proposed action because the buildings would be designed and constructed to provide additional confinement for any materials that might be released in the EBE.

4.3.1.5 Ecological resources

The Enhanced Storage alternative would not adversely affect any threatened or endangered species.

Aquatic Biota. Short- and long-term impacts to aquatic biota from the Enhanced Storage alternative would be no greater than those currently occurring from the Paducah Site activities. While there is some current evidence for toxicity to aquatic biota at one outfall (Appendix K), a plan for a toxicity reduction evaluation (TRE) has been submitted to state regulators for approval. The successful completion of the TRE should eliminate further toxicity.

Bioaccumulation studies for PCBs and mercury in fish show that concentrations are decreasing, which means that controls and remediation of sources have been effective. However, there is evidence of degradation in fish communities downstream of discharges from the Paducah Site, probably owing to high temperatures in the effluent or increases in sedimentation (Appendix K). These conclusions would not be affected by the Enhanced Storage alternative.

Accident impacts to aquatic biota from the worst-case accident scenario (i.e., earthquake) involving radionuclides are described in detail in Appendix C for the proposed action, and the impacts should be no greater for the Enhanced Storage alternative. Because of this, the earthquake scenario is highly unlikely to cause harm to aquatic biota in the Ohio River as a result of exposure to radionuclides. However, just as with the proposed action, aquatic receptors in Bayou and Little Bayou creeks and other water conveyances by which the waste would reach the Ohio River would likely be less affected under the Enhanced Storage alternative because less radioactive materials would escape from the storage facilities.

Accident impacts to aquatic biota from the worst-case accident scenario (i.e., earthquake) involving nonradionuclides are also described in Appendix C for the proposed action. Again, the impacts should be no greater for the Enhanced Storage alternative. PCBs could pose adverse impacts to aquatic biota in the Ohio River, as well as in Bayou and Little Bayou creeks. None of the other nonradionuclide contaminants would reach high enough concentrations in the Ohio River to pose adverse impacts to aquatic biota, according to the assumptions of the accident analysis.

Terrestrial Biota. Short- and long-term impacts to terrestrial biota from the Enhanced Storage alternative should be no greater than those currently occurring from the Paducah Site activities. Currently, there is some indication of impacts to terrestrial biota (Appendix K), deer and raccoon in particular, although the impacts appear to be minor and the ultimate causes and effects uncertain.

Impacts to terrestrial biota from the modeled worst-case spill accident scenario (i.e., earthquake) are no greater than for the proposed action. Just as for the proposed action, long-term radiation effects to soil biota as the result of an earthquake would be negligible under the Enhanced Storage alternative.

Accident impacts to terrestrial biota from the worst-case accident scenario (i.e., earthquake) involving nonradionuclides under the proposed action are described in Appendix C. The impacts to terrestrial biota under the Enhanced Storage alternative should be less. Nonradionuclides would likely pose less impact to soil biota if the worst-case spill accident occurred under the Enhanced Storage alternative.

4.3.1.6 Noise

Noise levels would be similar to those currently at the site.

4.3.1.7 Cultural and archaeological resources

The Enhanced Storage alternative is not expected to adversely impact any known cultural or archaeological resources.

4.3.1.8 Air quality

The Enhanced Storage alternative would result in the continuation of current DOE waste management activities. Under the Enhanced Storage alternative, potential impacts resulting from on-site treatment, transport, and disposal would not apply. Other potential impacts are presented in Sect. 4.1.1 and would be no greater than those identified for the proposed action.

4.3.1.9 Socioeconomics and environmental justice

Socioeconomic Impacts. The Enhanced Storage alternative may result in a slight increase in employment due to construction and/or upgrades required for storage facilities. In addition, long-term surveillance and maintenance of facilities designed to withstand increased EBE loads might result in additional staff.

Environmental Justice. Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations," requires agencies to identify and address disproportionately high and adverse human health or environmental effects its activities may have on minority and low-income populations. For the Enhanced Storage alternative considered in this EA, populations considered are those that live within 80 km (50 miles) of the Paducah Site.

Impacts from noise, air emissions, radiological emissions, and accidents would be low for both the residents closest to the site and the low-income communities. Exposures for the general public and the relevant workers would be no greater than those at historical levels for the Paducah Site (Appendix K).

4.3.2 Radiological and Nonradiological Impacts from the Enhanced Storage Alternative

The Enhanced Storage alternative would result in continued storage of LLW and TRU waste but would not address the long-term need for a final disposal plan. Potential impacts to the workers, public, and environmental resources are presented in this section.

4.3.2.1 Potential exposure of workers to radiological emissions

As described in Appendix K, worker doses under the No Action alternative would result in less than 1 LCF per waste type based on a worker population of 30 full-time employees. These doses would remain the same under the Enhanced Storage alternative because the work force required for storage facility workers would remain the same.

Additional workers might be required for building maintenance and surveillance activities for facilities that are designed to withstand increased EBE loads. However, these types of activities do not directly involve contact with stored materials and should not result in any additional exposures.

4.3.2.2 Potential exposure of the public to radiological emissions

The potential for public exposure to radiological emissions resulting from LLW and TRU waste management activities under the No Action alternative is limited at the Paducah Site. This potential would be further reduced under the Enhanced Storage alternative because the new/upgraded facilities would provide additional confinement to reduce the potential for radiological materials releases. Therefore, it is unlikely that the Enhanced Storage alternative would impact the public above current levels in terms of radiological impacts from continued storage of LLW and TRU waste.

4.3.2.3 Nonradiological risks to workers

Continued storage of LLW and TRU waste at the Paducah Site under the No Action alternative would increase safety risks to workers by requiring additional handling of the waste as maintenance and repackaging activities are needed. In addition, there would be routine monitoring activities in the storage locations that can present typical safety risks. These risks have been evaluated based on the average industrial accident rates for operations at similar industries. The estimated number of total recordable cases for the 30 workers associated with the No Action alternative would be 0.78 cases per year. The estimated lost workdays (LWDs) due to occupational illness or injury would be approximately 11 per year under the No Action alternative. These risks would remain the same under the Enhanced Storage alternative.

In addition, as waste inventories grow over time, additional storage facilities or upgrades of current facilities would be needed. This would require the use of heavy equipment and would introduce accident risks during facility construction.

4.3.3 Accident Analysis of the Enhanced Storage Alternative

During the No Action alternative, the packaged waste containers would be transported to an on-site location and stored. The containers would be inspected periodically to verify that the containers are intact and repaired if required. These containers would be subject to the same conditions as the stored containers in the proposed action. They would, however, be at risk for a longer period of time. These conclusions remain the same for the Enhanced Storage alternative.

The transformers would be moved to a new storage location under the Enhanced Storage alternative. Similar to the proposed action, accidents are postulated with the potential to breech the steel containers of the stored wastes and release the contents. The waste characteristics and the accident consequence methodology are the same as discussed for the proposed action in Appendix G and are the same for the Enhanced Storage alternative.

The EBE and vehicle impact/mishandling accidents were evaluated for the No Action alternative. The waste characteristics and the accident scenarios are the same for the Enhanced Storage alternative as those evaluated for the proposed alternative; however, the accident consequences would be expected to be less for the EBE because the enhanced storage facilities would provide additional confinement, thus reducing the amount of material released outside the building. The frequencies for both accidents remain the same as the No Action alternative.

4.3.4 Comparison of Accident Risks

As discussed in Sects. 4.1 and 4.2, risks have been computed for both process accidents and industrial accidents for the proposed action and the No Action alternatives. The highest radiological accident risk was 1.5×10^{-7} expected fatalities for the MIW/MUW at the edge of the waste storage area during and following an earthquake. This risk would be expected to be at least a factor of ten lower for the Enhanced Storage alternative because the buildings would provide additional confinement to reduce releases outside the facility. This risk would be computed for the 100-year no-action and enhanced storage institutional period. The second highest risk, 7.9×10^{-8} expected fatalities, was computed for the vehicle impact/mishandling accident impacting the ThF_4 container during the 10-year proposed action operating period. The risks are the same for all three alternatives, but the proposed action has a shorter duration. These risks are minor.

The industrial accident risks, while higher than the radiological accident risks, were small. The computed risk for the proposed action was 0.02 expected fatalities over the 10-year operating period. The corresponding industrial accident risk for the No Action alternative was 0.1 expected fatalities over the 100-year institutional control period and would be the same for the Enhanced Storage alternative. Neither the risks nor the differences between them are considered notable.

4.3.5 Transportation Impacts

Under this alternative, no Paducah Site waste would be transported off-site after expiration of current CXs. Therefore, there are no transportation impacts associated with this alternative.

4.3.6 On-Site Treatment Impacts

Under this alternative no on-site treatment would occur. All wastes would be maintained in storage facilities. Therefore, no treatment impacts are associated with this alternative.

5. CUMULATIVE IMPACTS

Cumulative impacts are defined as "...the impact on the environment which results from the incremental impacts of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or nonfederal) or person undertakes such other actions" (40 *CFR* 1508.7). Effects are considered cumulatively because significant effects are often the result of individually minor direct and indirect effects of multiple actions that occur over time. Cumulative effects should be considered over the "lifetime" of the effects rather than the duration of the action.

This section describes past and present actions, as well as reasonably foreseeable future actions, that are considered pertinent to the analysis of cumulative impacts for the proposed action. CERCLA activities that generate wastes are included in this section. It should be noted that considerable uncertainty as to scope and funding is associated with many of the future actions. Final decisions have not yet been made for some of these actions, and some are contingent upon additional NEPA analysis.

5.1 PADUCAH SITE ACTIVITIES

5.1.1 Environmental Management Program

The role of Environmental Management at the Paducah Site is to find, analyze, and correct site contamination problems as quickly and inexpensively as possible. Following is a list of ongoing Environmental Management projects with potential environmental impacts:

Paducah waste infrastructure

- construction of the C-746-U Landfill sedimentation pond discharge improvement.
- connection of C-746-U Landfill Phase 3 to leachate collection system.

Paducah waste operations

- performance of compliant operations of the C-746-U and C-746-S&T landfills.
- disposal of industrial waste/construction debris that met the waste acceptance criteria.
- analysis for a potential on-site CERCLA waste disposal facility.
- Paducah STP/MLLW project
- dismantling of the C-746-Q ^{99}Tc container.

Routine surveillance and maintenance

- pipeline isolation of abandoned fire water lines.

Long-term surveillance and maintenance

- working for uninterrupted Northwest/Northeast Plume Containment Systems for groundwater treatment.
- retrieval, staging, crushing and characterization of concrete rubble piles located on and off DOE property.

PAD Lasagna

The Paducah Site is a location of the Lasagna [TM] process for remediation of low-permeability soils. The Lasagna [TM] technology consists of emplacement of electrodes and use of direct current to electro-osmotically move water and contaminants through in situ treatment zones. One novel aspect of the technology is the capability to reverse electrical polarity, thereby reversing flow direction to more effectively sweep contaminants through the treatment zones.

- Continuation of system operations.

PAD groundwater fenceline action

- Conductance of Phase 1 Permeable Treatment Zone construction.
- Initiation of Phase 2 Permeable Treatment Zone construction.

PAD D&D C-410

- Pumping and treating water from basement of C-410 Complex.

Paducah Scrap Metal Removal and Disposal

The object of this project is to safely remove and disposition approximately 53,000 tons of contaminated scrap metal and miscellaneous materials contained in scrap yards. This project was initiated as a CERCLA project to address existing contamination and the potential release of hazardous substances to the environment.

5.1.2 Uranium Program

The Paducah Uranium Program has been established to provide surveillance and maintenance of DOE nonleased, inactive facilities and land areas not addressed by the Environmental Management program. There are a total of 15 inactive facilities and approximately 200 acres of land area that are maintained by the Uranium Program. Following is a list of ongoing Uranium Program projects with potential environmental impacts:

- Completion of cleanup of inactive facilities in accordance with cleanup plan.
- Maintenance of the deleased land acreage in a safe and compliant manner.
- Repaving Dyke and McCaw Road.

5.1.3 UF_6 Cylinder Storage

The mission of the UF_6 Cylinder Storage Program at Paducah is to maintain safe, long-term storage of the DOE UF_6 cylinder inventory until its disposition. The primary objective of the UF_6 Cylinder Storage Program is to implement the requirements of the Defense Nuclear Facilities Safety Board Recommendation 95-1 and applicable requirements of the Paducah Safety Analysis Report. The UF_6 cylinder storage facilities are Category II Nuclear Facilities as classified in accordance with the requirements of DOE Order 425.1A. The scope of work of the program includes surveillance and maintenance of cylinders transferred or scheduled to be transferred to DOE from USEC in accordance with the May 18, 1998, and June 30, 1998, memorandums of agreement between DOE and USEC. Following is a list of ongoing UF_6 Cylinder Storage Program projects with potential environmental impacts:

- restacking cylinders,
- annual cylinder inspections,
- quadrennial cylinder inspections,
- radiological surveys of cylinders,

- size reduction of G-yard concrete debris, and
- monthly sampling and monitoring of KPDES Outfall 017.

5.1.4 Depleted UF_6 Conversion Facility

In April 1999, DOE issued a final programmatic environmental impact statement, with preferred alternative, for long-term management of depleted UF_6 (DOE 1999b).

DOE has proposed to design, construct, and operate conversion facilities at the Paducah Site and at the Portsmouth Plant in Ohio. These facilities would convert DOE's inventory of depleted UF_6 now located at Portsmouth, Paducah, and the ETTP in Oak Ridge, Tennessee, to triuranium octaoxide, uranium dioxide, uranium tetrafluoride, uranium metal, or some other stable chemical form acceptable for transportation, beneficial use/reuse, and/or disposal. A related objective is to provide cylinder surveillance and maintenance of the DOE inventory of depleted UF_6, low-enrichment UF_6, natural assay UF_6, and empty heel cylinders in a safe and environmentally acceptable manner.

DOE currently plans to prepare an environmental impact statement for the purpose of construction, operation, and D&D of two depleted UF_6 facilities at the Paducah and Portsmouth sites. Among the potential impacts to be analyzed in the document will be the cumulative impacts associated with the facilities at both sites.

5.1.5 Disposal of Nonradioactive Wastes Containing Residual Radioactivity at the C-746-U Landfill

DOE is currently preparing appropriate supplemental NEPA documentation pertaining to the establishment of authorized limits to determine the acceptability of nonradioactive waste containing residual activity at the C-746-U Landfill. DOE intends to complete an EA for this activity within the next several months. This will also include a cumulative impacts analysis.

5.1.6 Long-Term Management Plan for DOE's Inventory of Potentially Reusable Uranium

DOE is in the process of preparing a programmatic EA for the implementation of long-term management of its inventory of potentially reusable low enriched uranium, normal uranium, and depleted uranium that is in excess of national security needs. DOE's inventories of these materials reside at more than 100 different sites, including the Paducah Site. As part of the EA, DOE will determine the safest, most effective, and most efficient location for the long-term storage of this material. The uranium EA will also include a cumulative impacts analysis.

5.1.7 USEC Programs

The PGDP is the only operating uranium enrichment facility in the United States. Owned by DOE, it is leased and operated by the USEC, a wholly owned subsidiary of USEC Inc. The plan employs about 1,500 people and provides enrichment services for commercial nuclear power plants in the United States and around the world. In May 2001, USEC completed a plan to consolidate its uranium enrichment operations at Paducah. Portsmouth now provides sampling, transfer, and shipping services for USEC's customers.

5.2 OTHER REGIONAL INDUSTRIES ACTIVITIES

Cumulative effects are derived by analyzing potential risks from the proposed action in conjunction with potential risks from other activities at the Paducah Site (listed above) and other regional industries.

Other industries located in the area include TVA's Shawnee Steam Plant, Honeywell's Metropolis Works, USEC, and the Joppa Power Plant. Other new potential sources of environmental impacts foreseeable in either McCracken County or Massac County in the near future are included generically in the impacts analysis.

5.3 CUMULATIVE IMPACTS FROM THE PROPOSED ACTION

Potential cumulative impacts that could occur from the proposed action for the Paducah Site and the other regional activities are presented in the following sections.

5.3.1 Land Use

Impacts from the other actions described in the previous sections have the potential to affect land and facility use at the Paducah Site. Actions that occur outside of the Paducah Site security fence could limit the land and facilities that could be developed for other purposes. Direct incremental impacts of the proposed action on the development of other properties in the region are unlikely.

5.3.2 Air Quality

The proposed action in combination with the other area actions is unlikely to have major impacts on local or regional air quality. The existing air quality of the region is considered to be good. Air emissions from the other actions described previously would be expected to have only minor impacts and not violate any air quality permits. This is because the actions would be controlled, to a large extent, by engineering controls and adherence to applicable regulations.

5.3.3 Soil and Water Resources

No construction-related disturbance of natural soils would occur under the proposed action. Environmental restoration activities could result in impacts if soils are disturbed to remove or treat contamination. These types of impacts would be temporary and mitigated through the use of best management practices. Accidental spills and releases of hazardous materials could also potentially impact soils. Impacts to the surface water and groundwater resources could also occur during activities, but they also would be mitigated. None of the actions discussed previously would be expected to have major discharges of industrial effluents that could adversely impact water resources. The removal and treatment of contaminated soils and groundwater and the D&D of contaminated facilities at the Paducah Site could have a beneficial impact on these resources due to the removal of the source of contamination.

5.3.4 Ecological Resources

Forest fragmentation and its associated impacts on biodiversity are increasing as more land is developed. However, development of land parcels at the Paducah Site would cause only minor impacts because none of the areas contain habitats or biota that are considered rare or unique. Additionally, no federal- or state-listed threatened and endangered species are known to exist in the area where the previously described actions are located. Emissions and effluents from the operation of the proposed action should not be of sufficient quantity to have a major adverse impact (i.e., stress, impairment, injury, or mortality) on existing habitats and biota. Accidental releases from ongoing and proposed operations would not greatly impact ecological resources due to the implementation of adequate mitigative measures.

5.3.5 Socioeconomics and Environmental Justice

The creation of new commercial/industrial jobs in the vicinity of the Paducah Site could contribute to cumulative socioeconomic impacts by inducing in-migration to the area, with corresponding demands for housing and public services. However, such in-migration is not likely to result from the currently planned activities. Even with the new projects, ongoing downsizing and workforce restructuring would continue, and employment from some of the proposed actions would be only temporary. In addition to the new direct employment in the area, new indirect jobs would be generated because new direct employment would create the need for the goods and services that are provided by indirect workers. However, these new indirect jobs also are not likely to stimulate in-migration, because nearly all the new indirect positions could possibly be filled with unemployed persons residing in the area.

No cumulative environmental justice impacts are expected to occur from any of the actions considered in this analysis, including those proposals that would be located at the Paducah Site.

5.3.6 Infrastructure and Support Activities

Cumulative transportation impacts in the region surrounding the Paducah Site could occur from increased development and growth as well as off-site shipments of other materials. Implementation of the proposed action discussed previously would not require any major upgrades to existing transportation systems or major new construction of roads or rail facilities. The potential for CERCLA waste disposal at a new Paducah Site facility would decrease traffic associated with waste material shipments off-site. Peak-hour traffic volumes could increase slightly over current levels but would depend on total employment numbers.

Associated with increases in traffic is the potential for an increased number of accidents, additional noise and air pollution, and road deterioration and damage. The increase in average daily traffic volumes could result in inconveniences for other vehicles on affected routes and connecting roads. Commercial operations could suffer temporarily reduced business while customers avoid affected areas because of traffic delays. Increased pavement deterioration and damage could increase costs associated with maintaining or resurfacing roads. Although noise associated with increased traffic is not normally harmful to hearing, increased traffic noise is considered by the public to be a nuisance. Increased accidents put an additional strain on local emergency response personnel. Increased vehicular traffic also has the greatest potential to increase air pollution in the local area, because emissions from motor vehicles are poorly regulated.

Existing utilities are considered to be sufficient for the actions in the Paducah Site area. The water and wastewater treatment plants also have enough capacity to handle the actions. Some of the systems may need to be modified or require minor upgrades, but no major utility system modifications are expected.

5.3.7 Human Health and Accidents

Cumulative public and occupational health impacts would be expected to be equal to those that currently exist in the Paducah Site area. Actions that involve environmental remediation and D&D usually have a positive impact by eliminating or reducing potential exposures to existing contamination. However, a certain amount of risk and potential exposure is involved for the workers who participate in the implementation of actions. Emissions and effluents released from industrial developments would not be expected to be a major source of potential exposure and would be controlled through the use of proper engineering and administrative controls. Standard industrial accidents would increase proportionally to the increase in facility numbers and actions taking place. Further development of the surrounding area could cause an increase in the number of people that could be exposed to off-site releases from large accidents.

5.4 CUMULATIVE IMPACTS FROM THE NO ACTION ALTERNATIVE

Potential cumulative impacts that could occur from the No Action alternative for the Paducah Site and the other actions described in Sects. 5.1 and 5.2 are presented in this section.

5.4.1 Land Use

No new facilities, or notable changes in land use, are described under the No Action alternative. Incremental impacts of this alternative on the development of other properties in the region are unlikely.

5.4.2 Air Quality

The No Action alternative, in combination with other area actions, is unlikely to have major impacts on local or regional air quality. The existing air quality of the region is considered to be good, and no new effluents are expected from the No Action alternative.

5.4.3 Soil and Water Resources

No construction-related disturbance of natural soils immediately would occur under the No Action alternative. In the future, as new storage facilities are constructed, short-term soil disturbance would occur. This minor disturbance, associated with the No Action alternative, in combination with other area actions is unlikely to have impacts on local or regional soil and water resources. Environmental restoration activities combined with construction-related disturbances under the No Action alternative could result in impacts if large quantities of soils are disturbed to remove or treat contamination. These types of impacts would be temporary and mitigated through the use of best management practices.

Impacts to the surface water and groundwater resources are not expected to occur during No Action alternative activities. No discharges are anticipated from implementation of the No Action alternative. None of the regional actions discussed previously would be expected to have major discharges of industrial effluents that could adversely impact water resources.

The removal and treatment of contaminated soils and groundwater and the D&D of contaminated facilities at the Paducah Site could have a beneficial impact on these resources due to the removal of the source of contamination.

5.4.4 Ecological Resources

Eventual construction of storage facilities on land parcels at the Paducah Site might cause minor impacts to the ecological resources of the area. Habitat loss and wildlife displacement would occur as a result of increased human presence at the new facility site. NEPA review would be conducted prior to construction startup to determine that the proposed construction site does not contain habitats and/or biota that are considered rare or unique.

No emissions or effluents from implementation of the No Action are expected. Accidental releases from ongoing operations on the site or in the region would not greatly impact ecological resources due to the implementation of adequate site controls.

5.4.5 Socioeconomics and Environmental Justice

In-migration of workers is not likely to result from the No Action alternative combined with regional activities. Any workforce increase would be offset by ongoing downsizing and workforce restructuring.

Employment from some of the actions would be only temporary. In addition to any new direct employment in the area, new indirect jobs would be generated because new direct employment would create the need for the goods and services that are provided by indirect workers. These new indirect jobs, however, also are not likely to stimulate in-migration, because nearly all the new indirect positions could possibly be filled with unemployed persons residing in the area.

No cumulative environmental justice impacts are expected to occur from any of the actions considered in this analysis, including the No Action alternative.

5.4.6 Infrastructure and Support Activities

Cumulative transportation impacts in the region surrounding the Paducah Site could occur from increased development and growth. No transportation impacts from implementation of the No Action alternative are anticipated, therefore, no major upgrades to existing transportation systems or major new construction of roads or rail facilities would be necessary.

No additional utility resources are required for the No Action alternative implementation. Existing utilities are considered to be sufficient for the actions in the Paducah Site area.

5.4.7 Human Health and Accidents

Cumulative public and occupational health impacts would be expected to be equal to those that currently exist in the Paducah Site area. The No Action alternative would result in keeping wastes on the Paducah Site. This results in more potential human health impacts than the proposed action since the proposed action would be removing wastes from the Paducah Site, thereby decreasing the human health impacts.

Actions that involve environmental remediation and D&D usually have a positive impact by eliminating or reducing potential exposures to existing contamination. A certain amount of risk and potential exposure, however, is involved for the workers who participate in the implementation of actions.

No emissions and effluents are expected to be released under the No Action alternative. Emissions and effluents from industrial developments would not be expected to be a major source of potential exposure and would be controlled through the use of proper engineering and administrative controls. Standard industrial accidents would increase proportionally to the increase in facility numbers and actions taking place. Further development of the surrounding area could cause an increase in the number of people that could be exposed to off-site releases from large accidents.

5.5 CUMULATIVE IMPACTS FROM THE ENHANCED STORAGE ALTERNATIVE

Potential cumulative impacts to land use, air quality, soil and water resources, ecological resources, socioeconomics, and area infrastructure from the Enhanced Storage alternative, in combination with other regional actions described in Sects. 5.1 and 5.2, are identical to the cumulative impacts described for the No Action alternative in Sect. 5.4. Both alternatives would affect these resources primarily through the construction of new storage facilities. The one area where these two alternatives differ is the potential cumulative human health and accident impacts.

5.5.1 Human Health and Accidents

Keeping the waste on site in an enhanced facility would increase the waste inventory that could be released during a catastrophe. This results in more potential human health impacts than the proposed action since the proposed action would be removing wastes and risks from the Paducah Site. The enhanced storage facility, however, would decrease potential human impacts by more strictly controlling storage area access, withstanding potential disasters (i.e.earthquakes), and containing container breeches more completely than standard storage buildings. Cumulative public and occupational health impacts would be expected to be less than those that currently exist in the Paducah Site area.

5.6 CUMULATIVE IMPACTS COMPARISON

It should be noted that none of the three alternatives result in notable impacts to the area's resources. For comparison purposes, however, the table below summarizes defined potential cumulative impacts of each alternative when combined with other regional activities. Each alternative is ranked between 1 and 3, with 1 indicating the least potential impact identified and 3 indicating the most impact when compared among the three alternatives. For example, the alternative with the most 1s would pose the least impact to resources when compared to the other two alternatives.

Table 5.1. Cumulative impacts comparison

Alternative	Land use	Air quality	Soil/water resources	Ecological resources	Socioeconomics	Infrastructure	Human health	Cumulative rank
Proposed	1	3	1	1	1	3	1	1
No Action	2	2	3	3	2	1	3	3
Enhanced Storage	3	1	2	2	3	2	2	2

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